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METHODOLOGY MANUAL FOR THE DETERMINATION OF THE MARGINAL COSTS --ETC(U)
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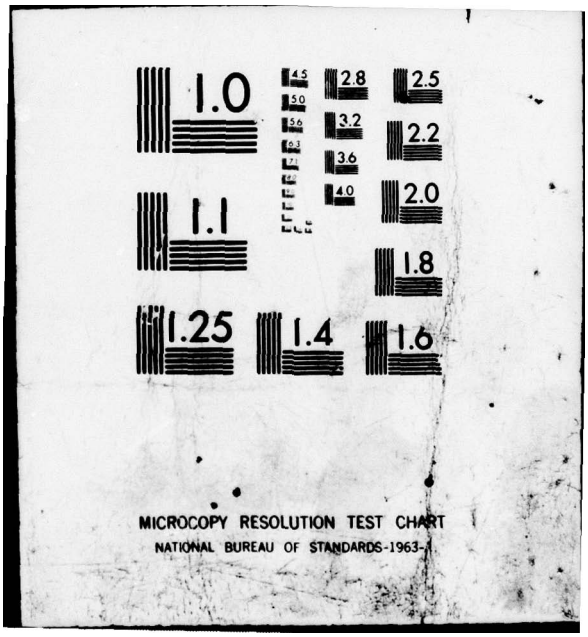
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METHODOLOGY MANUAL FOR THE DETERMINATION OF THE MARGINAL COSTS OF HEALTH SERVICES IN A MILITARY MEDICAL TREATMENT FACILITY

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December 23, 1977

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The methodology manual algorithmically describes data collection and manipulation procedures, to permit the calculation of marginal patient stay, clinic visit, and delivery costs for 39 distinct patient classes.

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THE ORKAND CORPORATION

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METHODOLOGY MANUAL FOR THE DETERMINATION OF THE MARGINAL COSTS OF HEALTH SERVICES IN A MILITARY MEDICAL TREATMENT FACILITY

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December 23, 1977

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Washington, D.C. 20310

THE ORKAND CORPORATION

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I. INTRODUCTION

1.1 BACKGROUND AND PURPOSE

The military Health Services System has five principal objectives:[1]

- To maintain a physically and mentally fit, combat and operationally-ready military force.
- To ensure the timely availability of health resources to provide support to approved combat, mobilization and contingency plans.
- To provide a program of health services to all eligible beneficiaries.
- To maintain a professionally viable and effective military health care system which is an incentive to the recruitment and retention of high-quality health professionals.
- To maintain a system of health services that functions as effectively and efficiently as possible.

In order to achieve these objectives, the Army Medical Department, along with the medical departments of the other services, utilizes health resources in military treatment facilities. However, these resources are limited in number and usually insufficient to meet objective three. In order to provide a complete program of health services to all eligible

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[1]Extracted from the Report of the Military Health Care Study, Department of Defense, DHEW, Office of Management and Budget, 1975.

beneficiaries, the Military Health Services System utilizes non-military health resources in civilian facilities financed through the CHAMPUS program.

Consistent with all other objectives, however, the decision to provide health services within a military hospital or through CHAMPUS to other-than-active-duty beneficiaries who reside within a forty-mile radius of a hospital depends on three factors:

- Whether the resources extant in a hospital because of that facility's major teaching mission are sufficient to meet the demand for services
- Whether utilizing CHAMPUS would place an undue burden on the private sector health resources because the military hospital resides in a "medically underserved area"
- Whether the marginal costs of providing health care to other-than-active-duty beneficiaries are lower in the military facility than are the costs of utilizing CHAMPUS.

It is this last criterion that is the concern of this methodology. For those military medical treatment facilities which do not reside in a medically underserved area nor have a major teaching responsibility, how does the Army determine the marginal costs of health care provided other-than-active-duty beneficiaries who reside within a forty-mile radius of that facility so as to determine the most effective and efficient means of fulfilling objective three of the military health services system.

1.2 ORGANIZATION OF THIS MANUAL

In detailing a methodology for the determination of the marginal costs of health care provided in a military medical treatment facility, this manual is organized as follows:

- Chapter II. Overview of Marginal Cost Measurement Methodology - This chapter delineates the conceptual background and framework of the marginal cost model.

- Chapter III. Constructing the Marginal Cost Model - This chapter details the various techniques to be used in completing the elements of the model for an Army hospital.

- Chapter IV. Determining the Marginal Cost of Health Services - Chapter IV is concerned with using the elements of the model to determine the marginal costs of care in an Army hospital.

- Chapter V. Methodological Issues - Finally, this chapter presents some conceptual and technical issues inherent in the model and its construction.

II. OVERVIEW OF MARGINAL COST MEASUREMENT METHODOLOGY

2.1 OPERATIONAL DEFINITION OF MARGINAL COST

Economists generally define marginal cost as the increment of total cost that comes from producing an increment of one additional unit of some good or service; that is, the term, marginal, means "extra". In the short run where some proportion of total costs are fixed, marginal cost curves are U-shaped-- at first falling due to increasing returns to scale, later rising as returns to fixed factors of production begin to decline. This concept is used by economists to explain rising short run supply curves of a firm or industry, production equilibrium, and maximum profit equilibrium.

Before a theory of marginal cost can be effectively utilized for the purpose of estimating marginal cost in selected Army hospitals, the concept requires considerable operationalizing with respect to:

- Particular Army hospital environment; e.g., period of marginal cost (MC) estimates, constraints, the nature of the decision and decision levels.
- How outputs are defined and counted (definitions are provided in Section 2.2 of this Manual).
- Conversion from an extra unit of hospital output to total costs "associated" with the additional output.

For purposes of this study, an operational definition of marginal cost is offered as follows:

"Marginal cost is operationally defined as the change in total cost of resources required by a military hospital, in excess of defined resource levels, in order to expand (or contract) services to non-active duty patients."

This definition applies to a hospital's short-run supply curve; i.e., certain costs are fixed. The time frame relevant to this analysis of MC estimates extends no longer than five years.

The above definition has within it several significant practical concepts that render it operational for the Army's analytical purposes. First, differences in total cost are defined in terms of increments (or decrements) to hospital service levels; not simply one more or less unit of service. Here the economist's strict definition is somewhat modified since the Army's decision will never be framed in terms of one more or one less unit of service. Rather, the policy issue will normally center upon greater fluctuations in hospital service levels.

The change in total cost depends upon what costs are "associated" with changes in service levels. The units of change in service levels have been defined elsewhere. The enumeration of costs associated with changes in units of service depends upon the definition of "defined resource levels".

The operational definition of marginal cost requires adaptation to the types of decision models faced by Army hospitals as they consider increasing hospital services to non-active duty personnel who would otherwise use the CHAMPUS reimbursement mechanism. There are three basic decision models, each of which require different operational specifications of marginal cost. All decision models have a 0-5 year time frame. The major distinction between the three decision models is at what resource level are resource costs considered fixed by policy decision. The three models are:

- What are the marginal costs of expanding hospital services levels beyond that which can be sustained using resource levels fixed by active duty workload requirements?

- What are the marginal costs of expanding hospital service levels beyond that which can be sustained by current resource levels of that hospital?

- What are the marginal costs of expanding hospital service levels beyond that which can be sustained by contingency level resource requirements assigned to the hospital?

The first decision model recognizes that resources required to serve active duty personnel are fixed by statute. If current hospital service levels do not exhaust these fixed resources, the marginal cost of increased demand upon these resources is minimal since most of the resources represent no costs. It is only when resource requirements exceed those which are considered fixed that marginal costs are considered significant. The other two decision models postulate other definitions of fixed cost. The operational definition of marginal cost then depends upon what costs are considered fixed; i.e., the three decision models. The estimation of marginal cost for any particular Army hospital then depends upon the decision model in question, current resources assigned to the hospital, and current patient loads.

The definition of marginal cost includes the cost of additional capital equipment and borrowed resources. It excludes any allocation of base support costs so long as such costs do not change as a result of changes in hospital service levels. The cost of capital goods will be defined as a straight-line depreciation over a maximum of eight years. All capital goods costing over $1,000 will be depreciated using this formula. Borrowed resources will be costed if not already charged to a hospital budget.

The above operational definition of marginal cost is clearly not simply a budget concept. Resource requirements to provide hospital service levels beyond the capability of defined resource limitations must be costed in a comprehensive manner. Some of the costs will have a financial or budgetary impact upon a hospital, such as acquisition of new capital goods and manpower, while other short-run resource acquisitions may not; e.g., borrowed labor or the use of labor that does not get charged to the hospital budget. Our operational definition of marginal cost employs the economist's perspective that all variable resources have "opportunity costs"; i.e., their value is the next best use. Therefore, the cost of all resources associated with hospital service levels beyond defined resouce constraints are considered marginal. Costs that would not appear directly in the hospital's budget will be allocated to marginal cost estimates by estimating the value or cost of the resource over the time within which it is used.

2.2 PATIENT CLASSIFICATION

Since the Army Medical Department provides a wide variety of health services to at least four discrete beneficiary categories, those services and beneficiaries have been organized into a three dimensional matrix. Exhibit II-1 illustrates this matrix which subsumes all possible services provided to all beneficiary categories in mutually exclusive cells. The first dimension of the matrix is the beneficiary categories: active duty personnel, dependents of active duty personnel, retired personnel, and dependents of retired personnel and survivors. The second dimension is the division of health care into six service categories: medical, surgical, obstetrics, gynecology, pediatrics, and all other services. The third dimension delineates three measures of services provided eligible beneficiaries: patient stay, ambulatory clinic visit and delivery. These are defined as follows:

- Patient Stay - An episode of inpatient health care, excluding obstetrical episodes, which occurs between the time a patient is admitted to a military hospital until discharge or other disposition.

- Ambulatory Clinic Visit - A nonobstetrical clinic visit not associated with inpatient health care status.

- Delivery - The total episode of health care associated with obstetrical services, to include inpatient and outpatient care.

The division of Army Medical Department health care delivery into this matrix accomplishes two objectives. It first accounts, in part, for the heterogeneity of health services. Since different mixes of resources are required to provide different services and since different population groups require different services, these patterns have been incorporated into the design of the matrix. Secondly, the matrix is decision oriented. The Army Medical Department is obligated without qualification to provide health care in the direct care system to the active duty beneficiary category. Each of the other categories is provided direct care as resources are available and on a priority basis among the three; or in the civilian community through CHAMPUS. The availability of resources in the direct care system and the

Exhibit II-1

Classification Matrix

Service Categories/ Measures \ Beneficiary Category		Active Duty	Dependents	Retirees	Dependents of Retirees & Survivors
Medical	Patient Stay				
	Ambulatory Clinic Visits				
Surgical	Patient Stay				
	Ambulatory Clinic Visits				
Obstetrics	Deliveries			a/	
Gynecology	Patient Stay				
	Ambulatory Clinic Visits				
Pediatrics	Patient Stay	a/		a/	
	Ambulatory Clinic Visits	a/		a/	
Other	Patient Stay				
	Ambulatory Clinic Visits				

a/ Probable null or very small sets.

demands for those resources among the beneficiary categories may be more effectively ascertained in the matrix format so as to form the basis of decisions to increase or decrease care provided to any or all of the other than active duty beneficiaries.

2.3 PRODUCTION FUNCTIONS

Based on the operational definition of marginal cost, it is necessary to determine the change in the total cost of resources associated with serving additional patients. To that end, a production function approach was taken. This approach assumes that there is a definite and measurable relationship between resources and patients. That is, one can model and measure the amount of resources required to serve each patient. In marginal costing, this approach means that if the amount of resources required by additional patients is greater than the existing amount, additional resources must be acquired. The costs of these additional resources, being a function of the additional patients, are therefore the marginal cost of adding the new patients.

In operation, this approach is complicated by two factors. One is that any patient receiving care in an Army hospital places a unique demand on resources. In no way can that demand be accurately measured until that patient presents himself for treatment. However, it is possible to ascertain an average patient demand for hospital resources. But the variability around this average may be so great as to render the average useless as a tool for measuring the resource/patient relationship. Hence the classification matrix groups patients into similar but sufficiently large classes. It is assumed that each patient demands a mix of resources similar to all other patients in its group such that the variability around the average demand in a class is less than the variability around the average demand if all patients were grouped as a whole. This classification scheme further assumes that the average demand for resources in one class is different from the average demand in all other classes.

The production function approach is further complicated by the fact that differentiated resources are grouped into organizational sub-units (i.e., departments) of a hospital. Hospital resources do not provide direct services to patients which may be measured but rather indirect services which are defined as departmental products. In other words, resources combine in departments to produce an output (i.e., products) and these departmental products are demanded by individual patients.

The production function approach to marginal costing as used in this methodology is predicated on developing the following relationships:

- Between departmental products and patients
- Between resources and departmental products
- Between costs and resources.

For the purposes of this manual, the following direct care hospital departments and their products will be considered:

- Medical Hospitalization (Bed days)
- Surgical Hospitalization - subdivided into:
  - Surgical Hospitalization I (Bed Days) - nursing wards
  - Surgical Hospitalization II (Episodes of surgery) - operating room, recovery room, anesthesiologists, and anesthesia nursing
- OB/GYN Hospitalization (Bed days)
- Pediatrics Hospitalization (Bed days)
- Other Hospitalization (Bed days)
- Medical Clinics (Clinic visits) - further subdivided into the individual clinics composing this department such as internal medicine, general outpatient, etc.
- Surgical Clinics (Clinic visits) - also subdivided into individual clinics
- OB/GYN Clinics (Clinic visits)
- Pediatrics Clinics (Clinic visits)
- Other Clinics (Clinic visits) - also subdivided into individual clinics

Additionally, the following ancillary departments will be considered:

- Radiology (Films exposed)
- Pathology (CAP weighted laboratory procedure unit values)
- Pharmacy (Prescriptions)
- Food Service (Meals served)

Finally the following indirect departments will be considered:

- Administration (various) - subdivided into individual sections
- Medical Material (Requisitions)
- Medical Maintenance (Jobs completed)
- Linen Service (Pieces of linen)
- Ambulance Service (Runs)

Each of these departments employ the following resource types to produce departmental products:

- Personnel - Identified by the following three categories:
  - Officers with Medical Specialties
  - Other Officers
  - Enlisted Personnel
- Materiel - Defined in terms of a "standard unit" of one; since materiel consists of a very large number of items but is very small (both absolutely and relatively) in comparison to other inputs, it is not cost-effective to specifically enumerate use of materiels by item or unit. Hence an "average cost" related standard unit (always defined as one) will be applied to each input function.
- Equipment - Defined in terms of each machine.

Exhibits II-2 through II-6 illustrate the relationships between resources and departmental products, and between departmental products and patient categories.

Finally, the marginal cost of health care delivered in an Army hospital becomes the cost of acquiring additional resources associated with additional patients served. The production function approach is therefore used to describe the following causal relationships:

- Increased patients served leads to increased production of departmental products (at the rate specified in the coefficients (a, b, k in Exhibits II-2 through II-5) corresponding to individual patient types and departments
- Increased production of departmental products leads to increased demand for resources at the rate specified in the coefficients (g, h, i in Exhibits II-2 through II-5) corresponding to departmental products and resource types.
- Increased demand for resources, leads to the need for additional resources if the capacity of existing resources is insufficient to meet the demand
- The need for additional resources leads to the incurrance of a cost to acquire those resources.

And these costs are marginal when applied to the additional patients which caused them.

Exhibit II-2

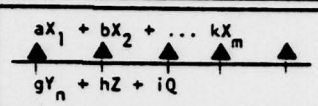
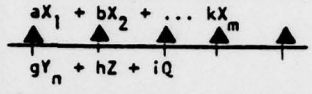
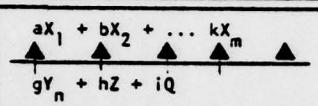
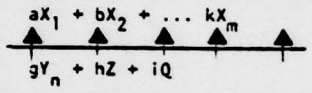
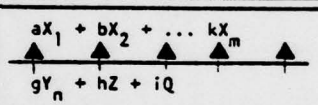
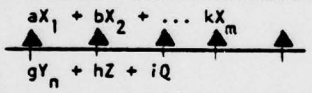
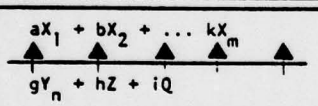
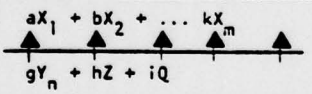
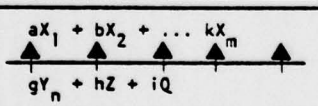
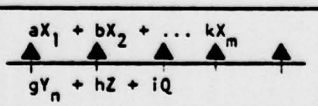
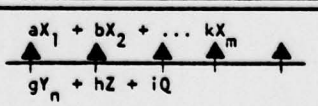
Active Duty Beneficiary Production Functions[1]

Output Categories		Functions
Service	Measure	
Medical	Patient Stay	$\frac{aX_1 + bX_2 + \ldots kX_m}{gY_n + hZ + iQ}$
	Ambulatory Clinic Visits	$\frac{aX_1 + bX_2 + \ldots kX_m}{gY_n + hZ + iQ}$
Surgical	Patient Stay	$\frac{aX_1 + bX_2 + \ldots kX_m}{gY_n + hZ + iQ}$
	Ambulatory Clinic Visits	$\frac{aX_1 + bX_2 + \ldots kX_m}{gY_n + hZ + iQ}$
Gynecology	Patient Stay	$\frac{aX_1 + bX_2 + \ldots kX_m}{gY_n + hZ + iQ}$
	Ambulatory Clinic Visits	$\frac{aX_1 + bX_2 + \ldots kX_m}{gY_n + hZ + iQ}$
Other	Patient Stay	$\frac{aX_1 + bX_2 + \ldots kX_m}{gY_n + hZ + iQ}$
	Ambulatory Clinic Visits	$\frac{aX_1 + bX_2 + \ldots kX_m}{gY_n + hZ + iQ}$
Obstetrics	Deliveries	$\frac{aX_1 + bX_2 + \ldots kX_m}{gY_n + hZ + iQ}$

[1]See explanation of notation at Exhibit II-6

Exhibit II-3

Active Duty Dependents Beneficiary Production Functions[1]

Output Categories		Functions
Service	Measure	
Medical	Patient Stay	
	Ambulatory Clinic Visits	
Surgical	Patient Stay	
	Ambulatory Clinic Visits	
Gynecology	Patient Stay	
	Ambulatory Clinic Visits	
Pediatrics	Patient Stay	
	Ambulatory Clinic Visits	
Other	Patient Stay	
	Ambulatory Clinic Visits	
Obstetrics	Deliveries	

[1] See explanation of notation at Exhibit II-6

Exhibit II-4

Retired Beneficiary Production Functions[1]

Output Categories		Functions
Service	Measure	
Medical	Patient Stay	$aX_1 + bX_2 + \ldots kX_m$ ▲ ▲ ▲ ▲ ▲ $gY_n + hZ + iQ$
	Ambulatory Clinic Visits	$aX_1 + bX_2 + \ldots kX_m$ ▲ ▲ ▲ ▲ ▲ $gY_n + hZ + iQ$
Surgical	Patient Stay	$aX_1 + bX_2 + \ldots kX_m$ ▲ ▲ ▲ ▲ ▲ $gY_n + hZ + iQ$
	Ambulatory Clinic Visits	$aX_1 + bX_2 + \ldots kX_m$ ▲ ▲ ▲ ▲ ▲ $gY_n + hZ + iQ$
Gynecology	Patient Stay	$aX_1 + bX_2 + \ldots kX_m$ ▲ ▲ ▲ ▲ ▲ $gY_n + hZ + iQ$
	Ambulatory Clinic Visits	$aX_1 + bX_2 + \ldots kX_m$ ▲ ▲ ▲ ▲ ▲ $gY_n + hZ + iQ$
Other	Patient Stay	$aX_1 + bX_2 + \ldots kX_m$ ▲ ▲ ▲ ▲ ▲ $gY_n + hZ + iQ$
	Ambulatory Clinic Visits	$aX_1 + bX_2 + \ldots kX_m$ ▲ ▲ ▲ ▲ ▲ $gY_n + hZ + iQ$

[1]See explanation of notation at Exhibit II-6

Exhibit II-5

Dependents of Retirees and Survivors Beneficiary Production Functions[1]

Output Categories		Functions
Service	Measure	
Medical	Patient Stay	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
	Ambulatory Clinic Visits	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
Surgical	Patient Stay	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
	Ambulatory Clinic Visits	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
Gynecology	Patient Stay	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
	Ambulatory Clinic Visits	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
Pediatrics	Patient Stay	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
	Ambulatory Clinic Visits	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
Other	Patient Stay	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
	Ambulatory Clinic Visits	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$
Obstetrics	Deliveries	$aX_1 + bX_2 + \ldots kX_m$ / $gY_n + hZ + iQ$

[1] See explanation of notation at Exhibit II-6

Exhibit II-6

Notation Used in Exhibits II-2 Through II-5

NOTATION	DEFINITION
aX_1	Amount of products of department 1 required
bX_2	Amount of products of department 2 required
kX_m	Amount of products of department m required
X_1, X_2, X_m	Units of product output denoted for each of the n departments
a, b, k	Coefficients denoting amount of X products required
gY_n	Amount of personnel time required, by category
hZ	Amount of material required
iQ	Amount of equipment required
Y_n	Units of time for each personnel category
Z	Measure of materials
Q	Measure of equipment usage
g, h, i	Coefficients denoting amount of each resource required
n	Subscript representing the 3 personnel categories

2.4 MARGINAL COST MODEL

To operationalize the production function approach and to determine the marginal costs of health care in a military treatment facility, then, a model has been designed which incorporates three information requirements: the specified relationships between departmental products and patient types, the resources required to produce departmental products to include the levels at which resources must be acquired to increase product outputs, and the costs of resources. These three elements of the marginal cost model are incorporated into the following:

- Table of Coefficients
- Departmental Tables
- Resource Cost Tables

Each of these tables is described in the remainder of this chapter.

2.4.1 Table of Coefficients

This table contains the specified relationships between the departmental products and patient categories. The left side of the table is the array of patient types classified by beneficiary category, service category, and service measure. The hospital departments are arrayed along the top of the table. These include five inpatient departments, five outpatient departments, four direct patient care ancillary departments, and five indirect product centers. Exhibit II-7 illustrates a blank Table of Coefficients.

In operation each cell of the table will contain the number of products of each department required to serve one patient classified in the categories along the left side for a given military treatment facility. For example, one medical active duty patient stay might require 5.7 bed days, 5.16 X-ray films exposed, 482.67 weighted laboratory procedures, 17.1 meals, 171.13 pieces of linen, and so forth.

For most departments only one coefficient is necessary; however, in certain outpatient departments, more than one clinic, each with its own resource usage patterns, compose the department. For example, the department of Medical Clinics may be composed of five separate clinics while the department of Surgical Clinics may be composed of ten. Since each component clinic of each department is utilized at a different rate by different beneficiaries, and each clinic has different staffing patterns, each coefficient must be developed separately.

Many of the cells will also be blank for several reasons. Since the hospitalization departments are service and inpatient specific, coefficients for each of these departments are associated only with corresponding patient types. For example, coefficients relating the use of the products of the department of Medical Hospitalization (bed days) to specific patient types would generally be found only in cells corresponding to medical patient stay patient types. The five clinics departments are also service specific such that coefficients relating the use of a clinic department's products to specific patient types are not found in cells corresponding to unrelated services. For example, a coefficient for surgical clinics would not be required in a gynecology patient cell. Finally, food services will normally

Exhibit II-7

An Example of a Blank Table of Coefficients

PATIENT TYPES			DEPARTMENTS										
BENEFICIARY	SERVICE	MEASURE	MED. HOSP.	SURG. HOSP.	OB/GYN HOSP.	PEDS. HOSP.	OTHER HOSP.	MED. CLINICS	SURG. CLINICS	OB/GYN CLINICS	PEDS. CLINICS	OTHER CLINICS	RADIOLOGY
ACTIVE DUTY	Medical	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Surgical	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Obstretrics	Deliveries											
	Gynecology	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Other	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
DEPENDENTS OF ACTIVE DUTY	Medical	Patient Stay											
		Inpatient Clinic Visits											
		Ambluatory Clinic Visits											
	Surgical	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Obstretrics	Deliveries											
	Gynecology	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Pediatrics	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Other	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
RETIRED	Medical	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Surgical	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Gynecology	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Other	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
DEPENDENTS OF RETIRED AND SURVIVORS	Medical	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Surgical	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Obstretics	Deliveries											
	Gynecology	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Pediatrics	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											
	Other	Patient Stay											
		Inpatient Clinic Visits											
		Ambulatory Clinic Visits											

	PHARMACY	FOOD SERVICE	ADMINISTRATION	LINEN	MED. MATERIAL	MED. MAINT.	AMBULANCE

not be used by ambulatory clinic visit patient types. Therefore coefficients relating the use of this department's products to patient types should be only in cells corresponding to patient stay.

2.4.2 Departmental Tables

In the production function approach, three types of resources required to produce departmental products and ultimately serve patients were specified: personnel, equipment and materiel. Since the unit of service provided by materiel resources was defined in terms of dollars and considered purely variable it is not necessary to separately account for their usage by specified patients outside of cost tables. However, personnel and equipment resources provide services independent of their costs. A second element of the model, therefore, accounts for these services. Personnel and equipment resource departmental tables specify the amount of each resource type required to produce departmental outputs.

Although each resource type provides variable input to the production of departmental outputs, the resources themselves can be purchased only in whole units. For example, each CAP (i.e., College of American Pathologists) weighted unit produced by the department of Pathology requires approximately one minute of time from a laboratory technician. But if the department produced from one to 10,400 CAP weighted units per month it would still need one technician because he can be acquired only as a whole unit with that range of capacity. The departmental tables are so constructed as to reflect this step-wise nature of personnel and equipment resources.

Each departmental table starts from a base point defined as the minimum staffing or equipment level required to establish the department. The next point in the table is the product output which is the maximum sustainable product output level of that mix of minimum resources. To increase departmental output beyond this level, an additional resource must be acquired. This additional resource, however, provides the capacity to produce a given amount of additional departmental products before a second additional resource is required.

In the example at Exhibit II-8, the seven personnel resources associated with zero product output are the minimum staffing level required to staff an operating room. They have the capacity to produce up to three episodes of surgery per month. With the acquisition of a Senior OR Specialist, however, the operating room can sustain levels of output between four and 19.

Exhibit II-8

Example of a Personnel Resource Departmental Table
Surgical Hospitalization II (Operating Room)

Product Output	Resource Constraint		
	Type [1/]	Code [1/]	Grade
0	Base = 4 Nurses	R-2	04/03/02
	Chief OR Specialist	R-3	E-7
	Senior OR Specialist	R-3	E-6
	OR Specialist	R-3	E-5
3	Senior OR Specialist	R-3	E-6
19	OR Specialist	R-3	E-5
35	OR Assistant	R-3	E-4
51	OR Specialist	R-3	E-5
67	Senior OR Specialist	R-3	E-6
83	OR Assistant	R-3	E-4
99	Clinical Staff Nurse	R-2	02
115	OR Specialist	R-3	E-5
131	Clinical Staff Nurse	R-2	02
154	Reports Clerk	R-3	E-4
182	Senior OR Specialist	R-3	E-6
209	Clinical Staff Nurse	R-2	02
237	Assistant Chief OR Specialist	R-3	E-6
	Assistant Chief OR Nursing (Upgrade)	R-2	03-04
	Chief OR Nursing (Upgrade)	R-2	04-05
264	OR Assistant	R-3	E-4
292	OR Specialist	R-3	E-5

Exhibit II-8 — Cont.

Product Output	Resource Constraint		
	Type	Code	Grade
319	Clinical Staff Nurse	R-2	02
347	Senior OR Specialist	R-3	E-6
	COMPOSITE	R-3	E-6

Exhibit II-8 -- Cont.

[1]"Type" refers to the actual designation of the resource while "code" refers to the three types of personnel resources as follows:

- Officers with Medical Specialties - R-1
- Other Officers - R-2
- Enlisted Personnel - R-3

But in general, no more than 19 episodes of surgery per month can be sustained without acquiring a ninth resource (OR Specialist) which provides the capacity to produce up to 35 episodes of surgery.

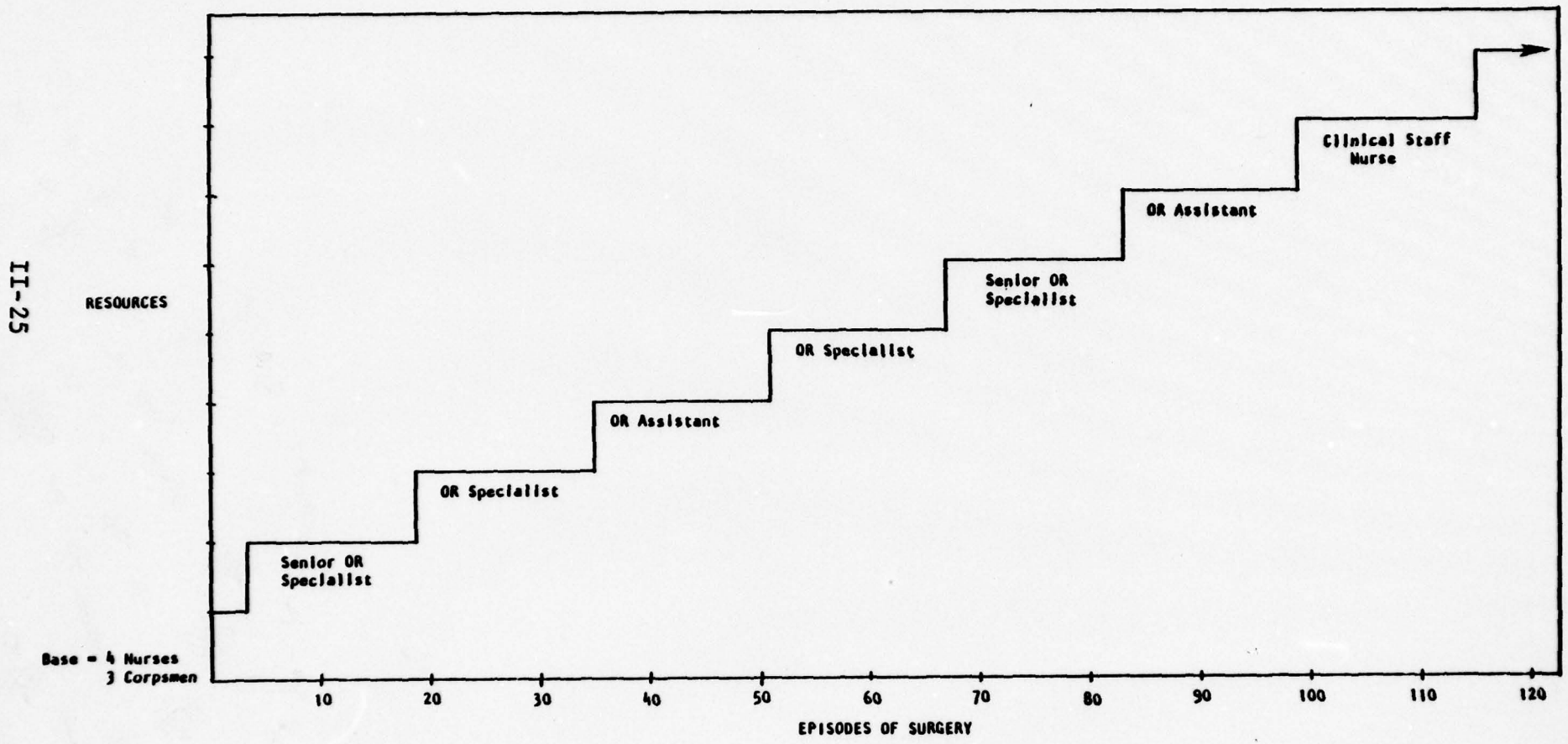
The table then is so constructed as to be additive and discrete. Graphically, this same table can be represented as in Exhibit II-9. The table is additive in that in order to produce up to nineteen episodes of surgery, the operating room needs the seven resources in the base plus a Senior OR Specialist. In order to produce up to twenty-five episodes, an OR Specialist must be added to the previous eight resources. The table is discrete in that whether the operating room needs to provide four, 19 or any number of episodes of surgery between four and 19, a whole resource (i.e., the Senior OR Specialist) must be acquired. Fifteen episodes of surgery can be said to be the range of this resource's capacity and nineteen episodes of surgery can be said to be the constraint on the mix of eight resources. That is, the seven resources in the base plus the Senior OR Specialist are constrained from producing more than 19 episodes of surgery (on a sustained basis) without a ninth resource (OR Specialist).

This departmental table is a series of constraint points, in terms of the product output of the department, at which resources must be acquired to sustain up to a given level of additional products. In Exhibit II-8, these constraint points are shown in the left column. The resources in the second column are those that at each constraint point need to be purchased to sustain production up to the next constraint point. The third and fourth columns are used to calculate the cost of each resource.

There is at a minimum one table for each department and subdivided department in the Table of Coefficients to account for personnel resource utilization. In addition, there should be one table for each type of physician (medical, surgical, OB/GYN, and other). Physician tables should be included separately to account for the reality that although physicians are authorized separately on the basis of bed days and on clinic visits, few physicians spend their time exclusively in either inpatient or outpatient care. All internists, for example, work on the medical ward and in the internal medicine clinic regardless of where they are slotted in a Table of Distribution and Allowances (TDA). Therefore, the tradeoffs between the two types of care

Exhibit II-9

Graphic Illustration of a Departmental Table



types of care must be shown on one scale such that a physician constraint in inpatient care may "borrow" underutilized physician time from outpatient clinics. The scale may be in terms of clinic visits as the product output of physicians and all inpatient requirements need only be translated into clinic visits to determine physician constraints.

2.4.3 Cost Tables

A third set of tables delineate the specific costs of resources which may be acquired to increase the productive capacity of individual departments. Due to the coding structure utilized in the departmental tables, all resources may be defined in terms of three categories of personnel resources, equipment, and material. The cost of each of these types of resources are delineated in three tables: personnel, equipment, and material.

The personnel resource cost table is a two-dimensional matrix with the three categories defining one dimension and the military pay grade structure defining the second. The cells then contain the dollar cost of a personnel resource type at defined pay grades. Military personnel cost figures are derived from the standard rates for costing military personnel services adjusted for:

- Retirement
- Wage Acceleration
- Physician Variable Incentive Pay

Civilian personnel are accounted for in a separate table, similarly structured, but using civilian rates of compensation at pay grades equivalent to military pay grades.

Another table is needed for equipment costs to account for the various types of equipment which may be acquired at equipment constraint points. This table is merely a list of equipment and their associated dollar costs adjusted for depreciation. Since all present equipment in a hospital has been purchased, and their associated costs expensed, only the costs of additional equipment associated with additional departmental product output are considered. And such costs should reflect the latest price.

The materiel cost table is merely the average materiel cost per patient type. It is calculated under the assumption that all materiel costs are variable. Therefore, the materiel costs associated with additional patients served are the average materiel costs per patient type times the number of incremental patients.

III. CONSTRUCTING THE MARGINAL COST MODEL

The marginal cost model embodied in this methodology and described in Chapter II is appropriate for any Army hospital. However, the usefulness of the model in any particular hospital depends upon utilizing facility specific characteristics in the model. Specifically, the beneficiary population, service demands and availability, and resource mixes in each hospital significantly affect the relationships described in the production function approach of the model. For example, a hospital located on an Army post which supports a combat division has a different service population than a hospital located on a post which supports a major command. These service populations place different demands on hospital services which necessitate different coefficients corresponding to patient types and departmental products. Similarly, a hospital without pediatricians provides limited, if any, pediatric services. This situation also affects the Table of Coefficients.

This chapter details the procedures for constructing each element of the marginal cost model using facility specific information for the following:

- Table of Coefficients
- Departmental Tables
- Resource Cost Tables

3.1 CONSTRUCTING THE TABLE OF COEFFICIENTS

This table specifies the use of departmental product outputs by specific patient types. The latter are classified by beneficiary category, service category, and service measure as shown in Exhibit II-7. Each department produces some defined product output which is required in varying quantities by different patients. This table delineates the expected consumption of each department's product output by the defined patient types.

In order to construct this table, it is first necessary to define a base period of time for analysis. At least one year's time, preferably broken down into months, should be sufficient. A second prerequisite to analysis is the actual number of patients served by type for the same base period. A third prerequisite is the product outputs of each of the departments, also for the base period. The coefficients are then developed as a function of the total number of patients served by type and the total products of each department for the base period. That is, how much of those total departmental products were demanded by each patient type over the base period.

This section provides the procedures used to determine the consumption rate of departmental products by patient types for the following sets of departments.

- Hospitalization
- Clinics
- Radiology and Pathology
- Pharmacy
- Food Service
- Ambulance Service
- Linen
- Medical Maintenance
- Medical Materiel
- Administration

3.1.1 Coefficients for Hospitalization

There are five hospitalization departments, one of which is divided into two sections. These are:

- Medical Hospitalization
- Surgical Hospitalization
  - Surgical Hospitalization I (nursing wards)
  - Surgical Hospitalization II (operating room suite)
- OB/GYN Hospitalization
- Pediatrics Hospitalization
- Other Hospitalization.

Each department's products are defined as the inpatient care required to treat patients in the patient stay or, in the case of obstetrics, delivery patient categories. That is patient types defined by the service measure "ambulatory clinic visits" would not utilize the products of these departments. Further, the departments are so stratified as to service such that:

- Only medical patient stay patient types would utilize products of the department of Medical Hospitalization.
- Only gynecology and surgical patient stay patient types would utilize products of the department of Surgical Hospitalization (both I and II).
- Only gynecology patient stay and obstetric patient types would utilize products of the departments of OB/GYN Hospitalization but gynecology patient types would utilize only the physician resources of this department.
- Only pediatrics patient stay patient types would utilize the products of the department of Pediatrics Hospitalization.
- Only "other" patient stay patient types would utilize the products of the department of Other Hospitalization.

The specific product output for each of these departments, except Surgical Hospitalization II, is patient (or bed) days. The product output of Surgical Hospitalization II is episodes of surgery. The hospital specific coefficient of bed days applicable to each patient type is constructed as follows:

Medical Hospitalization

- Step 1. From the Health Services Command, obtain the breakdown of dispositions by clinical service, by beneficiary category (active duty, dependents of active duty, retired, dependents of retired and survivors) by number of patients and bed days for the base year. See Exhibit III-1 for format.

- Step 2. Sum the number of bed days spent by active duty beneficiaries in the following clinical services:

  - General Medicine
  - Allergy-immunology
  - Cardiology
  - Endocrine-Metabolism
  - Gastroenterology
  - Hematology
  - Nephrology
  - Rheumatology
  - Pulmonary Disease
  - Infectious Disease
  - Dermatology

- Step 3. Divide the number of bed days obtained in Step 2 by the total active duty patients in those clinical services. The result is the average number of medical bed days spent by active duty beneficiaries in the base year, or the coefficient of Medical Hospitalization

Exhibit III-1

Minimum Report Format for IPDS Data Obtainable from HSC

Clinical Service	Patients				Bed Days			
	Active Duty	Dependents of Active Duty	Retired	Dependents of Retired & Survivors	Active Duty	Dependents of Active Duty	Retired	Dependents of Retired & Survivors
General Medicine								
Allergy-Immunology								
Cardiology								
Endocrine-Metabolism								
Gastroenterology								
Hematology								
Nephrology								
Rheumatology								
Pulmonary Disease								
Infectious Disease								
Dermatology								
Dental								
General Surgery								
Ophthalmology								
Otolaryngology								
Urology								
Hand Surgery								
Peripheral Vascular Surgery								
Thoracic Surgery								
Neurological Surgery								
Orthopedics								
Organ Transplant								
Obstetrics								
Gynecology								
Neurology								
Psychiatry								

applicable to an active duty, medical, patient stay patient type.

- Step 4. Repeat Steps 2 and 3 for the other three beneficiary types.

Surgical Hospitalization I

- Step 5. Sum the number of bed days spent by active duty beneficiaries in the following clinical services:

- - Dental
  - General Surgery
  - Ophthalmology
  - Urology
  - Hand Surgery
  - Peripheral Vascular Surgery
  - Thoracic Surgery
  - Neurological Surgery
  - Plastic Surgery
  - Head and Neck Surgery
  - Orthopedics
  - Organ Transplant

- Step 6. Divide the number obtained in Step 5 by the total active duty patients in those clinical services. The result is the coefficient of Surgical Hospitalization I applicable to an active duty, surgical, patient stay patient type.

- Step 7. Repeat Steps 5 and 6 for the other three beneficiary types.

- Step 8. Take the total number of bed days spent by active duty beneficiaries in the gynecology clinical service.

- Step 9. Divide the number obtained in Step 8 by the total active duty patients in that service. The result is the coefficient of Surgical Hospitalization I applicable to an active duty gynecology, patient stay patient type.

- Step 10. Repeat Steps 8 and 9 for the other beneficiary types.

Surgical Hospitalization II. The product output of this sub-department is episodes of surgery. This number is roughly (though not exactly) equivalent to the number of surgical and gynecology patient types. However, the determination of the exact coefficients of this sub-department applicable to particular patient types requires the following steps:

- Step 11. Obtain from the facility the total number of episodes of surgery experienced during the base year period. (This number may be determined by summing the data found on line 227 of the Supplemental Med-302 report over the twelve months of the base analysis year.)

- Step 12. Divide the total number of patients of all beneficiary categories admitted to the hospital under all of the surgical (e.g., dental, general surgery, orthopedics, etc.) plus the gynecology clinical services into the total episodes of surgery. The resulting number is the coefficient of Surgical Hospitalization II applicable to all surgical and gynecology patient stay patient types. This coefficient (or ratio), which should be close to 1.0, is the expected number of episodes of surgery each surgical or gynecology, patient stay patient type would require.

OB/GYN Hospitalization

- Step 13. Repeat Step 2 under Medical Hospitalization but for the obstetrics clinical service only.

- Step 14. Take the number obtained in Step 13 and divide by total active duty patients in the obstetrics clinical

service. The result is the coefficient of OB/GYN Hospitalization applicable to an active duty, obstetrics, delivery patient type.

- Step 15. Repeat Steps 13 and 14 for the other three beneficiary types.

- Step 16. Take the coefficients found in Steps 9 and 10 under Surgical Hospitalization I and repeat under OB/GYN Hospitalization. These coefficients specify the utilization of only OB/GYN physicians providing inpatient care and do not specify the OB/GYN inpatient nursing services required by gynecology patients. Note: The latter are developed in Steps 8 through 10.

Pediatrics Hospitalization

- Step 17. Sum the number of bed days spent by dependents of active duty beneficiaries in the pediatrics clinical service.

- Step 18. Divide the number obtained in Step 17 by the total dependents of active duty patients in that clinical service. The result is the coefficient of Pediatrics Hospitalization applicable to a dependent of active duty, pediatrics, patient stay patient type.

- Step 19. Repeat Steps 17 and 18 for dependents of retired and survivors beneficiary type.

Other Hospitalization. This department consists of the following two clinical services:

- Neurology
- Psychiatry

This department may or may not be available in particular hospitals. If one does exist, the following steps should be taken to determine the coefficients of this department applicable to other patient stay patient types.

- Step 20. Sum the number of bed days spent by active duty beneficiaries in the above two clinical services.

- Step 21. Divide the number obtained in Step 20 by the total active duty patients in those clinical services. The result is the coefficient of Other Hospitalization applicable to an active duty, other, patient stay patient type.

- Step 22. Repeat Steps 20 and 21 for the other three beneficiary types.

Where this department is not available, patients treated in these clinical services probably utilize products of the department of Medical Hospitalization. This must be ascertained at each facility but if the products of Medical Hospitalization are utilized by patients admitted to the hospital under either neurology or psychiatry clinical service, these clinical services must be added to the other eleven found in Step 2 under Medical Hospitalization. This will account for neurology and psychiatry patient's use of in-patient nursing services or hospitalization type departmental products.

Exhibit III-2 illustrates typical coefficients of the hospitalization departments applicable to two beneficiary categories for a specific hospital.

Exhibit III-2

Example of Hospitalization Coefficients For Specific Hospital

PATIENT TYPES			DEPARTMENTS				
BENEFICIARY	SERVICE	MEASURE	MED. HOSP.	SURG. HOSP. I	SURG. HOSP. II	OB/GYN HOSP.	PEDS. HOSP.
ACTIVE DUTY	Medical	Patient Stay	5.7	-	-	-	-
		Ambulatory Clinic Visits	-	-	-	-	-
	Surgical	Patient Stay	-	7.5	.903	-	-
		Ambulatory Clinic Visits	-	-	-	-	-
	Obstetrics	Deliveries	-	-	-	3.5	-
	Gynecology	Patient Stay	-	4.1	.903	4.1	-
		Ambulatory Clinic Visits	-	-	-	-	-
	Other	Patient Stay	2.7	-	-	-	-
		Ambulatory Clinic Visits	-	-	-	-	-
DEPENDENTS OF ACTIVE DUTY	Medical	Patient Stay	5.42	-	-	-	-
		Ambluatory Clinic Visits	-	-	-	-	-
	Surgical	Patient Stay	-	4.07	.903	-	-
		Ambulatory Clinic Visits	-	-	-	-	-
	Obstetrics	Deliveries	-	-	-	3.47	-
	Gynecology	Patient Stay	-	3.57	.903	3.57	-
		Ambulatory Clinic Visits	-	-	-	-	-
	Pediatrics	Patient Stay	-	-	-	-	3.56
		Ambulatory Clinic Visits	-	-	-	-	-
	Other	Patient Stay	-	-	-	-	-
		Ambulatory Clinic Visits	-	-	-	-	-

3.1.2 Coefficients for Clinics

There are five clinics departments including:

- Medical Clinics
- Surgical Clinics
- OB/GYN Clinics
- Pediatrics Clinics
- Other Clinics

Medical, Surgical, and Other Clinics, however, are further divided into their component, individual clinics. That is, the department of Medical Clinics is divided into the various clinics which are designated medical. These may include, depending on the facility, internal medicine, general outpatient, dermatology, allergy, cardiology, gastroenterology, pulmonary disease, etc. Similarly the department of Surgical Clinics should be divided into its component clinics which may include ophthalmology, optometry, otolaryngology, urology, surgery, physical therapy, etc. Those clinics which do not fall into one of the service-specific clinics should generally be termed "other". These might include family practice, community (or Army) health nursing, social work, mental hygiene consultation service, etc. Each clinics department then is defined by the clinics which compose it which individually provide care required to treat patients in the patient stay, ambulatory clinic visit and delivery patient categories. As is the case for the hospitalization departments, the clinics departments are also generally stratified as to service such that:

- Only medical patient types would utilize products of the department of Medical Clinics.
- Only surgical patient types would utilize products of the department of Surgical Clinics.
- Only gynecology and obstetrics patient types would utilize products of the department of OB/GYN Clinics.
- Only pediatrics patient types would utilize the products of the department of Pediatric Clinics.

All patient stay patient types, however, may use the products of the department of other clinics.

The specified product output of each of the departments is clinic visits. However, since three of the departments are each composed of a number of clinics, one clinic visit (or one product output of a department) in each of these departments is further composed of some part of a visit to each of the component clinics. For example, if the department of Medical Clinics is composed of three clinics: Internal Medicine, General Outpatient, and Dermatology, one product output of the department of Medical Clinics (one clinic visit) would consist of so many visits to the Internal Medicine clinic, so many visits to the General Outpatient Clinic, and so many visits to the Dermatology Clinic. And these amounts of visits to each of the component clinics should be expressed as a percentage of one product output (one clinic visit) of the department of Medical Clinics.

This process is further complicated, however, by the fact that different beneficiary patient types utilize the individual component clinics within a department at different rates. That is, of one product output of the department of Medical Clinics in the above example, an active duty, medical ambulatory clinic visit patient type would require a different mix of visits to the component clinics than would a retired, medical, ambulatory clinic visit patient type.

To illustrate this procedure, consider the example of the department of Medical Clinics and Exhibit III-3 following this page. As shown, each beneficiary patient type utilizes the component clinics of the department of Medical Clinics at different rates as well as utilizes the products of the department at different rates. However, it may be said that an active duty, medical, ambulatory clinic visit patient type demands one (1) product output of the department of Medical Clinics which product is composed of .7 visits to the Internal Medicine Clinic, .2 visits to the General Outpatient Clinic and .1 visits to the Dermatology Clinic. At the same time, in demanding one product output of the department of Medical Clinics, a retired, medical, ambulatory clinic visit patient type utilizes .857 visits to the Internal Medicine Clinic, .143 visits to the General Outpatient Clinic and 0.0 visits to the Dermatology Clinic.

The coefficients, then, of each of the clinics departments allocated to each patient type will be the percentage

Exhibit III-3

An Example of the Utilization of the Clinics
Composing the Department of Medical Clinics
by the Four Beneficiary Categories

Patient Type (Medical Ambulatory Clinic Visit)	Total Patients 1/	Department of Medical Clinics		
		Internal Medicine Clinic	General Out-Patient Clinic	Dermatology Clinic
Active Duty	1,000 (1.0)	700 (.7)	200 (.2)	100 (.1)
Dependents of Active Duty	2,000 (1.0)	800 (.4)	1,000 (.5)	200 (.1)
Retired	700 (1.0)	600 (.857)	100 (.143)	0 (0.0)
Dependents of Retired and Survivors	1,500 (1.0)	500 (.333)	900 (.6)	100 (.067)

1/ Equals total products of the department of Medical Clinics demanded by the total patients by type.

Note: Numbers in parentheses are the coefficients.

distribution of one product output of a department among the component clinics. In the example at Exhibit III-3, the coefficients of the department of Medical Clinics allocated to an active duty, medical, ambulatory clinic visit patient type would be .7, .2, .1; while those allocated to retired beneficiaries would be .857, .143, 0.0.

A somewhat different situation occurs concerning the utilization of the clinics departments by patient stay patient types. In the previous example, the sum of the coefficients of the component clinics of the department of Medical Clinics equals 1. That is each medical ambulatory clinic visit patient type (regardless of beneficiary) demands one product output of the department of Medical Clinics. The coefficients corresponding to the component clinics are merely discrete and mutually exclusive portions of that one product. A similar concept is used to describe the coefficient of the components clinics corresponding to patient stay patient types, but they will generally sum to a number other than one.

That is, the demand for clinic visits (product) of a clinics department by patient type is computed first. This may be 1.5, 2.3, or any number. The coefficients for the component clinics then would be mutually exclusive subsets of that number. For example, consider that an active duty medical patient stay patient utilizes 1.4 visits to the Internal Medicine Clinic and .4 visits to the Dermatology Clinic. Summing these two numbers, each active duty medical patient stay required 1.8 product outputs of the department of Medical Clinics. Of these 77.8% occur in the Internal Medicine Clinic and 22.2% occur in the Dermatology Clinic. But the appropriate coefficients of each of these clinics is 1.4 and .4 respectively. These coefficients describe the observed phenomena that 1.8 products of the department of Medical Clinics are required to serve one active duty medical patient stay patient; and these 1.8 products are distributed among the component clinics in the portions 1.4 to the Internal Medicine Clinic and .4 to the Dermatology Clinic. These coefficients relate the usage of each component clinic by this specified patient type.

In order to construct these coefficients it is necessary to obtain from the facility a breakdown of clinic vists for the base year by clinic, by beneficiary category, by inpatient and outpatient (ambulatory) clinic visits. Exhibit III-4 illustrates the proposed format to capture this information.

Exhibit III-4

Breakdown of Clinic Visits

	Clinic							
Month	Beneficiary Category							
	Active Duty		Dependents		Retired		Dep. of Ret., and Survivors	
	IP	OP	IP	OP	IP	OP	IP	OP
Totals								

To construct the coefficients for those departments composed of more than one clinic, perform the following steps:

- Step 1. Aggregate individual clinics into departments.
- Step 2. For Medical Clinics, take first the outpatient, or ambulatory, clinic visits and order them into a matrix of beneficiary category by component clinic as in Exhibit III-3.
- Step 3. For the active duty beneficiary category, determine the percentage distribution of total product outputs of the department of Medical Clinics (1000 in the example) for the department's component clinics (.7 for Internal Medicine, .2 for General Outpatient Clinic and .1 for Dermatology Clinic). That is, divide the number of visits to each component clinic (700, 200, and 100 respectively) by the total (1000) departmental product outputs. The results are the coefficients of each component clinic of the department of Medical Clinics applicable to an active duty, medical ambulatory clinic visit patient type.
- Step 4. Repeat Step 3 for the other beneficiary patient types.
- Step 5. Repeat Steps 2 through 4 for the departments of Surgical Clinics and Other Clinics using surgical and other ambulatory clinic visit patient types respectively.
- Step 6. Repeat Step 2 for inpatient clinic visits
- Step 7. For the active duty beneficiary category, divide the number of inpatient clinic visits occurring in each of the component clinics of the department of Medical Clinics by the total number of active duty, medical patient stay patient types (from Step 1, Section 3.1.1). The resulting figures are the coefficients of each component clinic of the department of Medical Clinics applicable to an active duty, medical patient stay patient type.
- Step 8. Repeat Step 7 for all other beneficiary categories.

- Step 9. Repeat Steps 6 through 8 for the department of Surgical Clinics and surgical patient stay patient types.

- Step 10. Repeat Step 6 for Other Clinics

- Step 11. Since the department of Other Clinics is not service specific, its product outputs may be utilized by any patient stay patient type. Therefore divide the number of active duty inpatient clinic visits occurring in each of the component clinics of the department of Other Clinics by the total number of active duty patient stay and delivery patient types regardless of service (i.e the sum of all active duty medical, surgical, gynecology, other patient stay and obstetric delivery patient types observed in the base year). The resulting figures are the coefficients of the component clinics of the department of Other Clinics applicable to active duty medical, surgical, gynecology and other patient stay and obstetrics delivery patient types.

- Step 12. Repeat Step 11 for the other beneficiary categories.

- Step 13. The coefficient of the department of Pediatrics Clinics applicable to pediatrics ambulatory clinic visit patient types (regardless of beneficiary) is 1.0.

- Step 14. The coefficient of the department of Pediatrics Clinics applicable to a dependent of active duty, pediatrics patient stay patient type is the total number of inpatient clinic visits in the pediatrics clinic by dependents of active duty during the base year divided by the total number of dependent of active duty, pediatrics patient stays during the base year

- Step 15. Repeat Step 14 for dependents of retired and survivors beneficiary category

- Step 16. The coefficient of the department of OB/GYN Clinics applicable to gynecology ambulatory clinic visit patient types (regardless of beneficiary) is 1.0.

- Step 17. Repeat step 14 substituting OB/GYN clinics and active duty gynecology patient stay patient types.

- Step 18. Repeat Step 17 for the other beneficiary categories.

- Step 19. From the IPDS data, determine the number of patients, by beneficiary category, admitted to the hospital under the obstetrics clinic service.

- Step 20. From the hospital information, determine the number of obstetric clinic visits demanded by the various beneficiary patient types (visits to the OB/GYN clinic are usually segregated into obstetrics clinic visits and gynecology clinic visits)

- Step 21. For active duty, obstetrics, delivery patient types, divide the number of visits to the Obstetrics Clinic by active duty beneficiaries, by the number of active duty patients admitted to the hospital under the obstetrics clinic service. The result is the coefficient of the department of OB/GYN Clinics allocated to active duty, obstetrics, delivery patient types.

- Step 22. Repeat Step 21 for the other beneficiary categories.

Exhibit III-5 is an example of coefficients of the clinics departments applicable to two beneficiary categories.

Exhibit III-5

Example of Clinics Coefficients for a Specific Hospital

PATIENT TYPES			DEPARTMENTS																				
			MEDICAL CLINICS					SURGICAL CLINICS										OTHER CLINICS					
BENEFICIARY	SERVICE	MEASURE	GEN'L O/P	ALLERGY	DERMA-TOLOGY	INTER. MED.	NEUR-OLOGY	SURG.	OPTH.	OPTOM-ETRY	ORTHO	ENT	PHYS. THER.	PODI-ATRY	RESP. THER.	UROL-OGY	ETR	OB/GYN CLINICS	PED. CLIN	COMM.H NURSE	PHCS	SOCIAL WORK	FAMILY PRACTICE
ACTIVE DUTY	Medical	Patient Stay	-	-	-	.001	-	-	-	-	-	-	-	-	-	-	-	-	-	.092	.021	.122	-
		Ambulatory Clinic Visits	.291	.016	.069	.103	.015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Surgical	Patient Stay	-	-	-	-	-	.949	.019	0.0	.596	.428	3.848	0.0	0.0	.310	0.0	-	-	.092	.021	.122	-
		Ambulatory Clinic Visits	-	-	-	-	-	.037	.057	.270	.168	.054	.104	.058	0.0	.070	.182	-	-	-	-	-	-
	Obstetrics	Deliveries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.6	-	.092	.021	.122	-
	Gynecology	Patient Stay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.092	.021	.122	-
		Ambulatory Clinic Visits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	-	-	-	-	-
	Other	Patient Stay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.092	.021	.122	-
		Ambulatory Clinic Visits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.116	.291	.366	.227
DEPENDENTS OF ACTIVE DUTY	Medical	Patient Stay	-	-	-	.060	-	-	-	-	-	-	-	-	-	-	-	-	-	.128	.004	.004	-
		Ambulatory Clinic Visits	.621	.230	.065	.072	.012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Surgical	Patient Stay	-	-	-	-	-	.278	.418	0.0	1.744	2.374	2.205	0.0	0.0	.308	0.0	-	-	.128	.004	.004	-
		Ambulatory Clinic Visits	-	-	-	-	-	.039	.057	.362	.105	.058	.073	.024	0.0	.056	.226	-	-	-	-	-	-
	Obstetrics	Deliveries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.6	-	.128	.004	.004	-
	Gynecology	Patient Stay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.128	.004	.004	-
		Ambulatory Clinic Visits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	-	-	-	-	-
	Pediatrics	Patient Stay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.128	.004	.004	-
		Ambulatory Clinic Visits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	-	-	-	-
	Other	Patient Stay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.128	.004	.004	-
		Ambulatory Clinic Visits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.254	.035	.044	.667

3.1.3 Coefficients for Radiology and Pathology

These two departments are treated concurrently because of the technique used to determine the coefficients of each applicable to particular patient types. The department of Radiology provides diagnostic X-rays in support of direct patient care while the department of Pathology provides diagnostic laboratory services.

The product output of the department of Pathology is defined as a unit value determined by the College of American Pathologists (CAP). Under the CAP unit value system, each laboratory test (e.g., complete blood count, urinalysis with routine microbiology, throat culture, culture sensitivity, etc.) is assigned a unit value which weights each test such that the complexity of each test is reflected in its unit value. These weights are based on the amount of technician time required to perform a test. In this system, then, the resources required to perform various tests are directly related to the complexity of each test such that if one patient requires more unit values than another, the department of Pathology must provide more resources to meet that demand.

The defined product output of the department of Radiology is films exposed. Although this product output measure is less exact than the Pathology unit value, it, too, better weights X-ray examinations by the resources required to produce them. Like the Pathology unit value system, one film exposed requires approximately the same resources as any other film exposed while each type of X-ray examination requires so many films exposed.

One of the techniques to be used in allocating the products of each of these departments to specific patient types is a sample survey of medical records. This involves taking one random sample of clinical (inpatient) records and a second random sample of outpatient records, recording the patient type for whom each record is maintained, recording the laboratory unit values and X-ray films exposed for each patient, aggregating unit values and films exposed into patient type categories, projecting the sampled unit values and films exposed to the universe of all patients by patient type, determining the percentage distribution of the total estimated unit values and films exposed among the patient types, applying these percentages to the actual total unit values and films exposed produced by each department, and finally dividing the unit values and films exposed determined in

the previous step by the number of patients in each patient category to arrive at the average utilization of the product outputs of the department of Pathology and Radiology by each patient type.

This process is accomplished through the following steps:

- Step 1. Choose a sample size of clinical records. It has been found that a sample size of 50 per patient class yields sufficiently valid coefficients. To determine a sample size in a hospital, multiply the number of patient stay patient classes served (i.e. beneficiary category times service category) by 50.

- Step 2. Divide the number obtained above into the total number of admissions, less newborns, experienced by the hospital during the base year. The result rounded to the nearest integer is the interval rate used to pull a systematic sample of clinical records. Although newborn infants are given their own medical record, they are not considered separate from the mother unless they are discharged separately. If the newborn stays in the hospital longer then the mother, he is admitted as a pediatrics patient upon the mother's discharge. In all respects, then, the record of care of interest is the record of the delivery to include care provided the newborn unless he is subsequently admitted as a pediatrics patient. Choosing a record of a newborn will yield no data and reduce the number of usable records.

- Step 3. Pull the sample. This involves the following substeps.

  - Obtain the patient log for the base year

  - Randomly choose a number from one to the result of Step 2 above.

  - Count that randomly chosen number of patients in the patient log from the first patient admitted to the hospital during the base year.

  - Choose that patient.

- Count the interval rate number more patients and choose that one. Continue counting and choosing until all patients admitted during the base year have been chosen. Exception: If a patient chosen is a newborn infant, do not choose that patient. Instead, choose the next patient in the log. Continue counting the interval rate from that patient.

- Pull from the clinical records the record associated with each patient stay chosen in the previous sub-step.

- Step 4. For each record chosen, record the patient type (beneficiary category and service--service measure need not be recorded since all patients are patient stay types).

- Step 5. Sum the Pathology unit values and Radiology films exposed within each record and associate with the patient type recorded. (See Exhibit III-6.) The unit values are determined by noting which laboratory tests were performed for this patient from the laboratory slips extant in the record, multiplying each test by its CAP unit value, and summing all such derived unit values. Radiology films exposed are determined similarly.

- Step 6. Aggregate results into patient types. That is, aggregate all active duty medical patients and the total unit values and films exposed associated with those patients, and continue aggregating across all other patients admitted to the hospital during the base year.

- Step 7. Project the sampled unit values and films exposed by patient type to the universe of all patients admitted to the hospital during the base year (see Exhibit III-7). This is accomplished by dividing the total patients admitted during the base year by beneficiary and service (Column (B)), by the number sampled in each category (Column (C)), multiplying this number by the total unit values or films exposed associated with each patient type (Column (D)) to arrive at the projected unit values (Column (E)). As in Exhibit III-7:

Exhibit III-6

Sample Worksheet to Record Pathology
Unit Values and Radiology Films Exposed
Associated with Specific Patient Types

Patient Type		Unit Values	Films Exposed
Beneficiary	Service		
Record whether Active Duty, Dependents of Active Duty, Retired, or Dependents of Retired and Survivors.	Record whether Medical, Surgical, Obstetrics, Gynecology, Pediatrics, or Other.	Record total unit values of tests (determined by laboratory test request slips) for each patient whose record was chosen.	Record total films exposed of X-rays (determined by X-ray request slips) for each patient whose record was chosen.

Exhibit III-7

Sample Projection of Sampled Unit Values
to the Universe of All Patients

Row	(A) Patient Type	(B) Total Patients	(C) Sampled Patients	(D) Sampled Unit Values	(E) Projected Values	(F) %
	Active Duty					
1	Medical	425	57	7967	59403	9.3
2	Surgical	1363	160	8751	74548	11.7
3	Obstetrics	187	25	3122	23353	3.7
4	Gynecology	48	8	807	4842	.8
5	Other	33	1	27	891	.1
	Dependents of Active Duty					
6	Medical	195	28	3153	21958	3.4
7	Surgical	598	80	4280	31993	5.0
8	Obstetrics	1884	239	27489	216692	33.9
9	Gynecology	290	33	1945	17092	2.7
10	Pediatrics	536	61	5360	47098	7.4
11	Other	2	0	0		
	Retired					
12	Medical	271	26	4008	41776	6.5
13	Surgical	179	24	3193	23814	3.7
14	Gynecology	2	0	0	0	
15	Other	2	0	0	0	
	Dependents of Retired					
16	Medical	220	22	2886	28860	4.5
17	Surgical	323	43	2591	19463	3.0
18	Obstetrics	78	10	1808	14102	2.2
19	Gynecology	152	22	1816	12547	2.0
20	Pediatrics	31	2	72	1116	.2
21	Other	0	0	0		

- Columns (B), (C) and (D) are known.

- In row 1 only: Divide the number in column (B) (425) by the number in column (C) (57)

- Multiply the result above (7.456) times the number in column (D) (7967). This result (59403) is the projected value. This calculation is a simple proportion stating that if 57 patients required 7967 unit values, then 425 patients must require 59,403 unit values (7,967/57 = 59,403/425).

- Repeat this process for rows (2) through (21). Perform this analysis for both unit values and films exposed for each patient type.

- Step 8. Determine the percentage distribution of the projected unit values and films exposed among the patient types (Column (F)). This is accomplished separately for unit values and films exposed by summing the projected values (Column (E) rows (1) through (21)) for all patient types and dividing the projected value for each patient type by this sum (e.g. column (E), row (1) divided by the sum of column (E), then row (2) divided by the sum of column (E), etc.). The sum of Column (F) then should be 1.0 (100%).

- Step 9. Obtain from the department of Pathology, the total CAP weighted unit values produced during the base year broken down into the following three categories:

  - Inpatient

  - Outpatient

  - Quality Control and Standard

  The CAP workload reporting system is organized along these lines so that this data is readily available.

- Step 10. Determine the total CAP weighted values actually produced in the department of Pathology in the base year applicable to inpatients. Tests performed for quality control and standard are necessary and are a product of the department but are not readily

identifiable to either inpatients or outpatients. Therefore the actual CAP values of tests performed for these purposes must be allocated between inpatients and outpatients. This is accomplished as follows:

- Add together the CAP units produced specially for inpatients and outpatients (from Step 9)

- Divide the CAP units produced for inpatients (from Step 9) by the above sum. This fraction is that proportion of the CAP values produced for quality control and standard applicable to inpatients

- Multiply the above fraction times the total CAP values produced for quality control and standard

- Add the number obtained above to the CAP values produced for inpatients (from Step 9). The result is the total CAP values, including quality control and standard, applicable to all patient stay and delivery patient types served during the base year

- Step 11. Obtain from the department of Radiology, the total number of films exposed during the base year broken down into those exposed for inpatients and those exposed for outpatients. This information should be readily obtainable.

- Step 12. It is assumed that the CAP weighted units and the films exposed during the base year were actually required by all the patients served during the same base year. It is then necessary to determine the allocation of these actual outputs produced among the various patient classes. Steps 10 and 11 resulted in a breakdown of these actual products into two broad classes of patients. It is then necessary to further allocate this workload among the categories of patients within these two broad classes. Step 8 yielded sufficient information to accomplish this task. The total CAP values associated with inpatients are to be allocated among the various classes by multiplying the percentages obtained in Step 8 times the actual total CAP values. That is:

- Multiply the percentage in column (F), line (1) of Exhibit III-7 times the actual total inpatient CAP values (including quality control and standard or the result of Step 10). The result is the amount of actual CAP values associated with active duty medical patient stay patient types

- Repeat the above substep for each of lines 2 through 21. Repeat this step (12) for films exposed.

- Step 13. Divide the unit values and films exposed determined in Step 12 by the number of patients admitted during the base year by patient type (Column (B)). The results are the coefficients of the departments of Pathology and Radiology applicable to the various patient types.

- Step 14. Pull a sample of outpatient records. This is accomplished in the following manner:

  - Count the number of shelves or drawers on or in which outpatient records are stored.

  - Determine the number of records which must be sampled from each shelf or drawer by dividing 1200 (expected minimum number of records which must be sampled to get an unbiased sample of patients which yields a sufficient number of patients in each patient class) by the number of shelves or drawers.

  - From each shelf or drawer, randomly select the number of records determined above.

- Step 15. Select outpatient clinic visits to be sampled. Each record may contain more than one instance of a visit to a clinic in the base year. Therefore, the sampler must randomly select one visit.

- Step 16. Repeat Step 4 above.

- Step 17. Record the total unit values and films exposed associated with the chosen clinic visit from the record of treatment.

- Step 18. Repeat Steps 6 through 13 above for ambulatory clinic visit patient types. The results are the coefficients of the departments of Pathology and Radiology applicable to ambulatory clinic visit patient types.

Technical Issues. The techniques described in Steps 1 through 18 above are relatively straightforward on the surface, but in practice are somewhat more difficult. The calculation of the coefficients of the departments of Pathology and Radiology is based on relatively complete and accurate data from patient medical records. A significant complication for this is the nature of the clinical laboratory workload reporting system.

A valid set of coefficients of the department of Pathology depends upon completing Step 5 accurately. This assumes that all laboratory tests performed for a patient are reported in the medical record and that it is possible to accurately count the CAP weighted units associated with each test. As to the first assumption, most, but not all, tests performed on inpatients are reported in the clinical record. The same cannot be said about outpatient records. In the case of clinical records, it can be reasonably assumed that the incidence of missing reports of laboratory tests performed is a random variable. If this is true, then the allocation of actual Pathology workload to actual patients (Step 9) accounts for that missing data.

In the case of outpatient records, it is more often true than not that reports of laboratory tests are missing from the file. In practice, then, it is necessary to attempt to read from the report of care, the tests that were ordered. It is then assumed that the tests ordered were performed. This is considered the "best" technique of sampling laboratory (and radiology) departmental products associated with individual patient types. The potentially serious error inherent in this technique is mitigated somewhat by the fact that only a very small number of types of tests are often performed for outpatients. The most common of these are throat cultures, pap smears and urinalyses (with routine microbiology) with complete blood counts (with and without differentials), veneral disease tests, and some common chemistry functions (liver function and electrolytes) somewhat less common.

As to the second assumption concerning Step 5, it is quite difficult to accurately count the number of CAP weighted units

associated with each test. The nature of the present reporting system is such that only tests performed are reported in a medical record, not CAP weighted units. Therefore it is incumbent upon the analyst to determine the CAP weighted units from reports of tests. The best recommendation is to enlist the services of laboratory personnel. Their expertise and knowledge would make this task far easier. Barring that, it is important to understand some of the factors and complications inherent in counting CAP weighted units from laboratory test reports.

First, tests are reported on a number of different forms. Exhibit III-8 lists the standard forms. SF 546 through 556 are usually found attached to SF 545 which is easily distinquished as it is yellow. SF 515 and SF 518, however, are full size forms found elsewhere in the record. These should not be overlooked. Each form may contain one or more reports of tests performed. Each test on each form must therefore be counted.

Another complication is the degree of automation of the laboratory. Typically, complete blood count (CBC) tests and chemistry tests may be automated. Whether a laboratory has such equipment affects the CAP weighted units associated with the tests. For example, a CBC performed on a Coulter S is worth 3 CAP weighted units. But the same test performed by a technician may be worth 14 units. It is essential then to know what equipment the laboratory uses, the tests that are performed on this equipment, the unit values for each test, and the format in which the tests are reported (the CBC performed on the Coulter S is usally reported on a form separate from SF 549).

The third difficulty, associated with the above complication, is that tests that can be performed on a machine are, in fact, sometimes performed by hand. This is especially true when the test is performed during other than normal duty hours. Usually this can be determined from the test report. Handwritten results usually indicate that the tests were performed by hand. Reports of tests performed on machines are usually printed by the machine and easily recognizeable.

A fourth difficulty is that automated tests and non-automated tests may be reported on the same form. This is true of a CBC with differential. The CBC performed on a Coulter S will be reported on a preprinted form. But the differential, performed by hand, will also be reported on the same form.

Exhibit III-8

List of Laboratory Test Report Forms

SF 514	Clinical Record--Laboratory Reports
SF 545	Clinical Record--Laboratory Display
SF 546	Chemistry I
SF 547	Chemistry II
SF 548	Chemistry III (Urine)
SF 549	Hematology
SF 550	Urinalysis
SF 551	Serology
SF 552	Parasitology
SF 553	Microbiology I
SF 554	Microbiology II
SF 555	Spinal Fluid
SF 556	Immunohematology
SF 557	Miscellaneous
SF 515	Clinical Record--Tissue Examination
SF 518	Clinical Record--Blood Transfusion

The major issue concerning Radiology films exposed is the nature of the weighting scheme. Unlike the CAP system, there is no common system for valuing X-ray examinations. The number of films normally exposed per examination is a function of the Chief, Radiology. It is he who sets the policy as to how many views will normally be taken for each examination. Each view (lateral, oblique, etc) constitutes one film exposed. Therefore, it is important to obtain a list from the department of Radiology in each hospital detailing the examinations and the normal number of films exposed for each.

3.1.4 Coefficients for Pharmacy

The department of Pharmacy provides drugs and sterile products directly and indirectly, through nursing wards, other hospital departments and clinics, to patients. The product output of Pharmacy is defined as prescriptions. However, in order to relate the utilization of Pharmacy resources to the product output, a system of weighting various Pharmacy work units is used. This system developed by the pharmacy consultants to The Surgeons General of the three military services weights ward bulk orders, clinic bulk orders, sterile product preparations and unit dose ward preparations in terms of prescriptions based on the technician time required to fill one prescription. This system is as follows:

- A prescription equals one (1) full work unit.
- A ward or clinic bulk order work unit equals 20% (or .2) of a prescription.
- A sterile product preparation equals three (3) prescriptions.
- A unit does preparation equals 30% (or .3) of a prescription

The pharmacy typically maintains records of:

- The number of new regular prescriptions filled, to include the amount of additional time required to fill more complex prescriptions (expressed as "additional work units" equivalent to the time required to fill another prescription).
- The number of refilled prescriptions.
- The number of controlled prescriptions issued.
- The "work units" associated with filling ward and clinic orders (where one work unit = 20% of a prescription).
- The number of sterile products prepared.
- The number of unit dose drugs prepared.

The pharmacy further maintains the prescription slips (regular, refill and controlled), the actual ward and clinic bulk orders (with work units recorded on each order), the request for sterile products (with the actual products prepared recorded on each request), and medication profiles of patients for unit dose preparations. It is usually possible, then, to determine for all types of work units (prescriptions, bulk orders sterile products and unit doses), the service and service measure patient type receiving the product outputs of the department of Pharmacy. This may be determined as all prescriptions are issued to outpatients and include a physician's signature (which physician is assigned to a particular clinic associated with a particular service such as medical, surgical, etc.); clinic bulk orders are issued to service specific clinics; ward orders are issued to primarily service specific inpatient departments; and sterile products and unit doses are issued to particular patients (generally inpatients).

Depending on data availability, it may also be possible to specify sterile products and unit dose as to beneficiary as well as service and service measure. In some hospitals, the requests for sterile products and/or the unit dose medication profiles are imprinted with a patient name and other data including beneficiary status. In other hospitals, this data is not maintained. All other types of pharmacy work units may generally not be specified as to beneficiary. The only way to allocate the department of Pharmacy product outputs to specific beneficiary patient types is to use the percentage distribution of beneficiary types within service and service measure categories.

The techniques to use to calculate the coefficients of the department of Pharmacy applicable to specific patient types are as follows:

Prescriptions. It is necessary to sample both regular and controlled prescriptions since the distribution among patient types is different for each (statistically tested at one site and found significant). Refills and "additional work units," however, may be considered as distributed in the same ratio as regular prescriptions. The techniques for sampling and allocating regular and controlled prescriptions are identical and involve the following steps:

- Step 1. Ascertain the total number of prescriptions filled during the base year. Example: 120,000.

- Step 2. Since these prescriptions can only be distributed among service, ambulatory clinic visit patient types, only 400 need to be sampled. Divide the number of total filled prescriptions by 400. Example: 120,000/400 = 300. The result (300) is the interval rate for choosing prescriptions to be sampled.

- Step 3. Randomly select a number between 1 and the number obtained above (300). Example: 249.

- Step 4. Count, from the first prescription filled in the base year up to the number obtained above (249). Choose that prescription.

- Step 5. Note from the physician's signature (signature registers are available in the Pharmacy), the clinic of origin of the patient receiving the prescription. This is determined from the physician as he is usually assigned to a particular clinic. In exceptional cases, the clinic itself may be identified on the prescription as well.

- Step 6. Count another interval rate number (300) of prescriptions and choose another (549). Repeat Step 5. Continue sampling until all prescriptions have been chosen.

- Step 7. Aggregate prescriptions into service categories. It is expected that some prescriptions will have originated in a dental clinic. Include these as a seventh service category.

- Step 8. Determine the percentage distribution of the sampled prescriptions among the service categories. That is:

  - Sum the number of prescriptions found in all service categories (should be 400)

  - Divide the number of prescriptions aggregated into the medical service by the above sum. The result is the percentage of the sampled prescriptions which were found to be applicable to medical ambulatory clinic visit patient types

- Repeat the above step for the remaining six categories (including dental)

- Step 9. Repeat Steps 1 through 8 for controlled prescriptions.

- Step 10. For regular prescriptions, take the total number of regular, refill and "additional work unit" prescriptions filled during the base year and apply the percentage distributions obtained in Step 8 to this total. That is, using the percentages found in Step 8, multiply each by the total of all regular prescriptions actually filled during the year. The results are the total prescriptions actually filled during the base year (which presumably were necessary to serve all actual ambulatory clinic visit patients during the same period) allocated among the seven service categories.

- Step 11. Repeat Step 10 for the total controlled prescriptions actually filled during the base year.

An alternative to Steps 2 through 6 exists, however, which is somewhat more convenient. In this alternative, it is not necessary to sample systematically from the universe of all prescriptions but rather from discrete sub-sets (or clusters) of that universe. The steps to follow in this alternative procedure are as follows:

- Step 2(A). Since prescriptions are usually bundled in groups of 1000, randomly choose four bundles from the total number of bundles of prescriptions filled during the base year. Example: 120 (120,000 prescriptions/1000 prescriptions per bundle).

- Step 3(A). Randomly select a number from 1 to ten. Example: 6

- Step 4(A). Take one of the four bundles and count from the first prescription in that bundle up to the number obtained above (6). Choose that prescription.

- Step 5(A). Repeat Step 5 above.

- Step 6(A). Count 10 more prescriptions and choose that tenth one. Repeat Step 5(A). Continue sampling until all prescriptions in the first bundle have been sampled. Repeat steps 4(A) through 6(A) for the other 3 bundles. After all four bundles have been sampled, 400 data observations have been recorded and the procedure continues from Step 7 above.

Bulk Orders. It is expected that ward and clinic bulk orders will be aggregated together and ordered in date sequence. This means that there will be 365 groups of bulk orders unsegregated into ward and clinic orders. If unsegregated, only one sample of size 800 need be taken. If segragated, two samples of size 400 each must be taken. This methodology assumes unsegregated orders although the techniques described below would not be different if two instead of one sample were chosen.

- Step 12. Determine the total number of orders processed during the year. This may be known. If not, select a specific month of the base year randomly. Count the number of orders processed during the month (Example: 213) and multiply by 12 which yields an estimate (Example: 2,556) of the total number of orders processed during the year.

- Step 13. Take the number obtained in Step 12 (2,556) and divide by 800 to yield an interval rate for sampling orders (Example: 3).

- Step 14. Randomly select a number between 1 and the number obtained in the above step (Example: 2).

- Step 15. Count the orders from the first processed to the number obtained in Step 14 and choose that order.

- Step 16. Record from the chosen bulk order, the ward or clinic which placed the order and the number of work units required to process the order. Both should be identified on the bulk order request.

- Step 17. Count the interval rate number of orders to choose the next order and repeat Step 16. Repeat this step until all bulk orders have been sampled.

- Step 18. Aggregate all work units into the wards and clinics.

- Step 19. Aggregate all clinics work units into service categories.

- Step 20. Repeat Steps 8 and 10 for all clinics bulk orders work units processed.

- Step 21. Aggregate work units processed to medical wards, obstetrics wards, pediatrics wards and "other" wards into service categories.

- Step 22. It may be necessary to allocate work units processed to surgical wards (including operating suite, male surgical ward, female surgical ward) into surgical and gynecology service patient types. This is accomplished as follows:

  - Take the work units processed to each surgical ward (operating suite, male surgical, female surgical). Example: 200 to operating suite, 300 to male surgical, 500 to female surgical.

  - Obtain the Med-260 report (available from the Patient Administration Office at the facility) and determine the number of patient days spent in the facility by surgical patients who were female (Example: 200) and by all gynecology patients (Example: 300). The sum of these two numbers equals the demand for bulk order work units processed to the female surgical ward.

  - Determine the work units processed to surgical wards applicable to gynecology. This equals the percentage of total demand for the female surgical ward applicable to gynecology patients (gynecology patient days divided by total patient days in the ward, or, in the example 300/500 = 60%) times the work units applicable to this ward (500; 60% x 500 = 300); plus the percentage of total surgical plus gynecological patients (Example: 200 surgical and 100 gynecology patients = 300) who are gynecology patients (100/300 = 33.3%) times the work units

applicable to the operating suite (200; 33.3% x 200 = 67). These two figures added together equal the total work units processed to surgical wards which are applicable to gynecology patients (300 + 67 = 367 work units applicable to gynecology patients).

- Determine the work units processed to surgical wards which are applicable to surgery patient types. Take the total work units processed to surgical wards (1,000) and subtract the amount of these units applicable to gynecology patients (367). The result (1,000 - 367 = 633) equals the work units applicable to surgical patients.

- Step 23. Determine the percentage of the total sampled ward bulk order work units, the work units determined for each of the service categories bears. That is, of the total work units sampled, what percentage are medical, what percentage are surgical, etc. (See Step 8 above)

- Step 24. Take the total ward bulk order work units processed during the base year and apply the percentage distributions obtained in Step 23 to this total (see Step 10 above). The resulting figures are the total actual ward bulk order work units produced during the base year applicable to specific service, patient stay patient types and must be allocated to specific beneficiaries within the service, patient stay categories.

Sterile Products. Depending on data availability these products may be allocated directly to specific patient types (beneficiary x service x service measure) as follows:

- Step 25. Ascertain the total number of requests for sterile products processed during the base year. This does not equal the total sterile products prepared because each request may contain from one to six or more sterile products prepared. This may be accomplished in the same manner as in Step 12 above. (Example: 8,000.)

- Step 26. Take the number obtained in Step 25 and divide by 800 to yield an interval rate for sampling sterile products (Example: 10).

- Step 27. Repeat Steps 14 and 15.

- Step 28. Record from the sterile product request the specific patient type by cross-referencing the beneficiary category imprinted on the request, the physician ordering the product and the ward to which the product was delivered.

- Step 29. Associate with the patient type, the number of sterile products actually prepared. This may be determined usually from the reverse side of the request form. Each sterile product delivered is usually recorded on the reverse of the request by a control number or merely listed.

- Step 30. Count the interval rate number of requests to choose the next request and repeat steps 28 and 29. Repeat Step 30 until all sterile product orders have been sampled.

- Step 31. Aggregate all sterile products delivered into specific patient categories.

- Step 32. Determine the percentage distribution of the sampled sterile products delivered among the specific patient types. That is first sum the number of sterile products aggregated by patient type (from Step 31). Then divide the number of sterile products aggregated into active duty, medical patient types by the sum, those aggregated to active duty surgical patient types by the sum, etc. (See Step 8).

- Step 33. Apply the percentages found above to the total actual sterile products processed during the base year (See Step 10). The results are the total sterile products applicable to particular patient types.

If the sterile product records do not identify the beneficiary status of the patient, alternative procedures must be used. Specifically these procedures are identical to Steps 12, 13, 14, 15, 16, 17, 21, 22, 23 and 24 substituting sterile products for ward bulk drug orders.

Unit Dose Preparations. Unit dose programs are essentially optional in each hospital. Some have one and some do not. If

one exists, however, it is necessary to sample and allocate these work units to individual patients. A medication profile is an essential ingredient of a unit dose program. This profile is a record of medications ordered for and delivered to each individual patient. One profile usually records all medications for one episode of care (i.e., one patient stay). Like sterile products, the patient class (including beneficiary status) is usually ascertainable from the profile. Therefore, these products may be allocated directly to specific patient types as follows:

- Step 34. Ascertain the total number of unit dose profiles processed during the base year. This does not equal the total unit doses prepared because each profile may contain from one to hundreds or more unit doses prepared. This may be accomplished in the same manner as in Step 12 above. (Example: 8,000.)

- Step 35. Take the number obtained in Step 25 and divide by 800 to yield an interval rate for sampling unit dose profiles (Example: 10).

- Step 36. Repeat Steps 14 and 15.

- Step 37. Record from the unit dose profile the specific patient type by cross-referencing the beneficiary category imprinted on the profile, the physician ordering the medications and the ward to which the unit doses were delivered.

- Step 38. Associate with the patient type, the number of unit doses actually administered. This number is either recorded on the profile or it must be calculated by summing the record of individual unit doses administered.

- Step 39. Count the interval rate number of profiles to choose the next profile and repeat steps 37 and 38. Repeat Step 39 until all profiles have been sampled.

- Step 40. Aggregate all unit doses sampled into specific patient categories.

- Step 41. Determine the percentage distribution of the sampled unit doses prepared among the specific patient types. That is first sum the number of unit doses aggregated by patient type (from Step 40). Then divide the number of unit doses aggregated into active duty, medical patient types by the sum, those aggregated to active duty surgical patient types by the sum, etc. (See Step 8).

- Step 42. Apply the percentages found above to the total actual unit doses prepared during the base year (See Step 10). The results are the total unit doses applicable to particular patient types.

If the unit dose profiles do not identify the beneficiary status of the patient, alternative procedures must be used. Specifically these procedures are identical to Steps 12, 13, 14, 15, 16, 17, 21, 22, 23 and 24 substituting unit doses for ward bulk drug orders.

Consolidation. At this point, all of the various work units of the department of Pharmacy must be weighted, allocated to specific patient types, summed by type and then divided by total patients by type to determine the coefficients. The following steps are needed to accomplish this:

- Step 43. Consolidate ambulatory clinic visit pharmacy work units first. From Step 10, the number of prescriptions applicable to service, ambulatory clinic visit patients for the base year is known. Also the number of patients by type is known. In the example at Exhibit III-9, column (b) is known. To complete column (c), allocate the known prescriptions allocated to medical service among the four beneficiaries in the ratio each bears to the total. This is accomplished by dividing the number contained in column (b) row (1), by the total of column (b) rows (1), (6), (12) and (16) and multiplying this percentage times the total prescriptions allocated to medical service (from Step 10). The result of this calculation is a number in column (c), row (1). Column (c), row (6) may be completed by dividing the number in column (b) row (6) by the above sum of column (b) rows (1), (6), (12) and

Exhibit III-9

Sample Worksheet to Determine the Coefficients of the Department of Pharmacy to Specific Ambulatory Clinic Visit Patient Types

Patient Type	Numbers of Clinic Visits	Prescriptions	Controlled Prescriptions	Clinic Orders		Total	Average
				Unweighted	Weighted		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Active Duty							
1. Medical							
2. Surgical							
3. Obstetrics							
4. Gynecology							
5. Other							
Dependents of Active Duty							
6. Mecical							
7. Surgical							
8. Obstetrics							
9. Gynecology							
10. Pediatrics							
11. Other							
Retired							
12. Medical							
13. Surgical							
14. Gynecology							
15. Other							
Dependents of Retired							
16. Medical							
17. Surgical							
18. Obstetrics							
19. Gynecology							
20. Pediatrics							
21. Other							

(16) and multiplying this percentage times the total prescriptions allocated to medical service (again from Step 10). Repeat these calculations for all other medical, ambulatory clinic visit beneficiary categories. Repeat a similar calculation for surgical patients using column (b) rows (2), (7), (13) and (17). Repeat calculations for all other service types as follows:

- Obstetrics patients: rows (3), (8) and (18)
- Gynecology patients: rows (4), (9), (14) and (19)
- Pediatric patients: rows (10) and (20)
- Other patients: rows (5), (11), (15) and (21)

- Step 44. Repeat Step 43 for controlled prescriptions (obtained from Step 11).
- Step 45. Repeat Step 43 for clinic orders (obtained from Step 20).
- Step 46. Multiply each number obtained in Step 45 by .2 to complete column (f).
- Step 47. Add columns (c), (d), and (f) in each row to complete column (g).
- Step 48. Divide each number in column (g), by the corresponding number (i.e., on the same row) in column (b) to complete column (h). These numbers in column (h) are the coefficients of the department of Pharmacy applicable to specific ambulatory clinic visit patient types.

Consider Exhibit III-10. If the beneficiary status of each patient using sterile products and unit doses were known (i.e. from Steps 33 and 42, not the alternatives), columns (b), (c), (d) and (h); rows (1) through (21) are known. To complete the construction of the coefficients of the department of Pharmacy applicable to all patient stay and delivery patient types, use the following procedures:

Exhibit III-10

Worksheet to Determine the Coefficients of the Department of Pharmacy to Specific Patient Stay and Delivery Patient Types

Patient Type	Number of Patients	Number of Patient Days	Sterile Products		Ward Orders		Unit Doses		Total	Average
			Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Active Duty										
1. Medical										
2. Surgical										
3. Obstetrics										
4. Gynecology										
5. Other										
Dependents of Active Duty										
6. Medical										
7. Surgical										
8. Obstetrics										
9. Gynecology										
10. Pediatrics										
11. Other										
Retired										
12. Medical										
13. Surgical										
14. Gynecology										
15. Other										
Dependents of Retired										
16. Medical										
17. Surgical										
18. Obstetrics										
19. Gynecology										
20. Pediatrics										
21. Other										

- Step 49. To construct column (e), take the numbers in column (d), obtained from Step 33, and multiply each by the factor 3.

- Step 50. Repeat Step 43 to construct column (f) of Exhibit III-10, using the percentage distribution of column (c) to allocate the work units obtained in Step 24 to specific beneficiary categories. That is:

  - Sum column (c) rows (1), (6), (12) and (16) of Exhibit III-10

  - Divide the number in column (c) row (1) by this sum

  - Multiply the dividend obtained above times the number of ward bulk orders aggregated into the medical service category obtained in Step 24. The result of this calculation is entered in column (f), row (1)

  - Divide the number in column (c) row (6) by the sum of column (c) rows (1), (6), (12), and (16)

  - Multiply this dividend times the number of ward bulk orders aggregated into the medical service category (from Step 24). The result is entered in column (f), row (6)

  - Repeat this procedure using column (c) rows (12) and (16) to complete column (f) rows (12) and (16)

  - Repeat this procedure for the other service categories as follows:

    - Surgical patients - rows (2), (7), (13) and (17)

    - Obstetrics patients - rows (3), (8) and (18)

    - Gynecology patients - rows (4), (9), (14) and (19)

    - Pediatrics patients - rows (10) and (20)

    - Other patients - rows (5), (11), (15) and (21)

- Step 51. Multiply each number in column (f) by a factor of .2 to construct column (g).

- Step 52. To construct column (i); multiply each number in column (h) by a factor of .3.

- Step 53. To construct column (j), sum columns (e), (g) and (i) across rows.

- Step 54. Divide each number in column (j) by the corresponding number (i.e., on the same row) in column (b) to complete column (k). These numbers in column (k) are the coefficients of the department of Pharmacy applicable to specific patient stay and delivery patient types.

If, however, the beneficiary status of patients receiving sterile products and/or unit doses is not known, an alternative technique is necessary. At the very least, the total actual sterile products and unit doses allocated to each of the six service categories is known. To complete columns (d) and (h) of Exhibit III-10, then, follow the same procedure described in Step 50 substituting column (d) for column (f) in the case of sterile products; and column (h) for column (f) in the case of unit doses.

Technical Issues. The product output of the department of Pharmacy is one of the hardest to define and allocate to the various patient classes. The weighted system used in this methodology lends much toward a definition of a homogenous product output. But the data systems used by various pharmacies is a great obstacle to accurate allocation.

Concerning the output definition, some hospital pharmacies utilize even more work measures than is accounted for in this methodology alone. For example, some pharmacies prepack certain non-prescription drugs which are commonly demanded by a relatively large number of patients. These prepacks, often called handouts, are reported as separate work units. In order to simplify an already complicated methodology, it is recommended that these work units be lumped with prescriptions and treated accordingly.

Another issue is that there are two types of controlled drugs. Schedule II drugs are hard narcotics (codeine, morphine, etc.) while Schedule III, IV and V drugs (usually grouped together) are controlled because they are often abused. Examples of this latter group are amphetimines and barbiturates and include librium and valium . The former group of controlled substances are used rather infrequently but the latter are not. When the methodology refers to a sample of controlled prescriptions it refers to prescriptions for Schedule III, IV and V drugs. The Schedule II drugs should not be sampled but the total prescriptions for these drugs should be included in the total of all actual controlled prescriptions filled during the base year. Again, this technique is merely simplifying.

As for the allocation, this methodology presupposes that most workunits can not be specifically identified with beneficiary categories. In fact, in some hospitals, no workunits can be so identified. These facts result in less accurate coefficients. This obtains because the only way to allocate work units to beneficiaries assumes that each beneficiary class utilizes the products at the same rate as any other beneficiary class.

A final technical issue is pharmacy recordkeeping systems. Each pharmacy has virtually its own unique system. Fortunately there are enough common elements so that the methodology is useful. For example, all pharmacies use the same prescription form, bulk drug order forms are essentially similar, and sterile product requests contain basically similar information. But the different structures has left its mark on this methodology in the form of alternative sampling procedures for sterile products and unit doses.

3.1.5 Coefficients for Food Service

The department of Food Service provides meals for patients, hospital staff and patient guests. The defined product output of the deparment of Food Service is meals served. Since no meals are required by inpatient clinic visit and ambulatory clinic visit patient types, the coefficients of the department of Food Service apply only to patient stay patient types.

The Table of Coefficients relates the utilization rate of departmental products by patients only. Therefore, all non-patient meals are ignored in this computation but accounted for separately in the methodology. The coefficients of the department of Food Service applicable to individual patient types are constructed as follows.

- Step 1. Multiply the coefficient of the department of Medical Hospitalization applicable to active duty medical patient stay patient types by 3. This calculation merely states that if each patient spends X number of days (the coefficient of Medical Hospitalization) in the hospital, he will consume 3 times X meals during that period. The result is the coefficient of the department of Food Service applicable to active duty medical ptient stay patient types.

- Step 2. Repeat Step 1 for all other medical patient stay patient types

- Step 3. Repeat Steps 1 and 2 for:

  - Surgical and Gynecology patient stay patient types and the department of Surgical Hospitalization I

  - Obstetrics delivery patient types and the department of OB/GYN Hospitalization

  - Pediatrics patient stay patient types and the department of Pediatrics Hospitalization

  - Other patient stay patient types and the department of Other Hospitalization or Medical Hospitalization (whichever is utilized by these patient types)

Non-patient meals must be accounted for to calculate a marginal cost. These meals do affect the available capacity of the department of Food Service. A measure of non-patient meals must be calculated, then, that can be used in the marginal cost calculation (Chapter IV). This measure is the number of meals per staff member per month. Since additional patients may necessitate additional staff resources, this measure indirectly relates non-patient meals to patients. As additional patients necessitate additional staff, this additional staff generates increases in the product output of the department of Food Service.

To construct this measure proceed through the following steps:

- Step 4. Obtain the average staff and the average number of non-patient meals (non-patient rations times 3) served per month over the base year. Include guest meals with staff meals. The former is usually very small relative to staff meals and is simplifying to group them together.

- Step 5. Divide the average number of meals by the average staff. The result is the expected number of meals to be consumed per month by the hospital staff. Use of this factor is discussed in Chapter IV.

3.1.6 Coefficients for Ambulance Service

The Ambulance Service provides emergency and routine transportation of patients to and from the hospital and routine transfer and delivery of departmental products of other product centers. The specified product output of this department is runs. A run is further defined as the actual transportation of a patient or departmental product to or from the hospital. It has been found that the Ambulance Service transports only inpatients and primarily products of the department of Pathology. Patient transportation requires an attending emergency medical technician with a driver, while the transport of laboratory tests requires only the driver. To equate these types of movements, therefore, the transportation of a patient is defined as one (1) full run while the transportation of a non-patient is defined as only .5 of a run.

The calcultion of the coefficients of this department can be rather simple or quite complicated. A complicated technique, however, does not materially affect the coefficient or the marginal cost calculations. Therefore the simple technique is as follows:

- Step 1. Obtain from the Ambulance Service the number of patient runs and the number of non-patient runs during the base year.
- Step 2. Multiply the total non-patient runs by .5 and add this product to the patient runs.
- Step 3. Divide the sum obtained in Step 2 by the total number of patient stay patient types served during the base year (IPDS data). The result is the coefficient of the department of Ambulance Service applicable to each and every patient stay and delivery patient type.

3.1.7 Coefficients for Linen

The department of Linen distributes clean linen to and receives soiled linen from the departments, and arranges for the exchange of clean for soiled linen from the central laundry. The department of Linen is also responsible for the repair and replacement of damaged or non-usable linen inventory. The product output of the department of Linen has been specified as pieces of linen.

This department is an indirect product center and, as such, provides its product output to other departments of the hospital. The allocation of the product outputs of the department to specific patient types, then depends on the utilization of the product output of Linen Service by these departments, then the subsequent utilization of the product outputs of these other departments by specific patient types. That is, the product output of the department of Linen is an input to the product output of the other departments and the number of pieces of linen used by particular patient types is a direct function of their utilization of the products of these direct product centers. The techniques used to allocate linen to particular patient types, therefore, rests on determining the number of pieces of linen required for each product output of each direct care or ancillary department, multiplying these factors by the coefficients of these departments applicable to specific patient types, then summing these products across patient types. The steps in this process include the following:

- Step 1. Determine the total number of pieces of linen delivered to each hospital department in the base year. If records to this effect are not regularly maintained, this information must be estimated through sampling. Generally, the department of Linen Service maintains linen requests received from the other hospital departments. And these are usually maintained on a monthly basis. Randomly choose four months of requests.

- Step 2. From each request in each of the four months record the hospital department placing the request and the number of pieces of linen actually delivered.

- Step 3. Aggregate the data recorded in Step 2 into the categories identified in column (A) of Exhibit III-11. Put these aggregated data in column (B).

- Step 4. Sum column (B)

- Step 5. Obtain, from the Supplemental Med-302 report, the total number of pieces of linen delivered during the base year.

- Step 6. Divide the number obtained in Step 5 by the number obtained in Step 4. This is a blowup factor to estimate the actual distribution of pieces of linen among the departments from the sample distribution.

- Step 7. Complete column (C) of Exhibit III-11. This is accomplished by multiplying the numbers on each and every line of column (B) by the blowup factor obtained in Step 6. The sum of column (C) should equal the number obtained in Step 5.

- Step 8. Complete column (D) with the total actual products of each department in column (A) during the base year (e.g. total medical bed days, total Pathology CAP weighted units, etc.)

- Step 9. Divide column (C) row (1) by column (D) row (1) and enter the result in column (E) row 1. This number is the pieces of linen required per product output (bed day) of the department of Medical Hospitalization.

- Step 10. Repeat Step 9 for each row to determine the pieces of linen per product output of each department.

- Step 11. Multiply column (E) row (1) of Exhibit III-11 times the coefficient of the department of Medical Hospitalization applicable to active duty medical patient stay patient types. Insert the result in column (B) row (1) of Exhibit III-12. This result is the amount of products of the department of Linen Service passing through the department of Medical Hospitalization to these patients.

- Step 12. Repeat Step 11 for dependents of active duty by multiplying the number in column (E) row (1) times the coefficient of the department of Medical Hospitalization applicable to dependents of active duty medical patient stay patient types and insert the result in column (B) row (6) of Exhibit III-12.

Exhibit III-11

Worksheet for the Allocation of Linen Services-I

(A) Department	(B) Sampled	(C) Total	(D) Products	(E) Linen/Product
(1) Medical Hospitalization				
(2) Surgical Hospitalization I				
(3) Surgical Hospitalization II				
(4) OB/GYN Hospitalization				
(5) Pediatrics Hospitalization				
(6) Other Hospitalization				
(7) Medical Clinics				
(8) Surgical Clinics				
(9) Obstetrics Clinic				
(10) Gynecology Clinic				
(11) Pediatrics Clinic				
(12) Other Clinics				
(13) Radiology				
(14) Pathology				
(15) Food Service				
(16) Ambulance				
(17) Pharmacy				
(18) Other 1/				
(19) Total				

1/ Includes dental clinics, veternary services, satellite clinics, etc.

Exhibit III-12

Worksheet for the Allocation of Linen Services - II (Inpatient)

(A) Patient Type	(B) Bed Days	(C) Surgery	(D) Clinics	(E) Radiology	(F) Pathology	(G) Food Serv.	(H) Ambulance	(I) Pharmacy	(J) Total	(K) Patients	(L) Coefficients
Active Duty											
(1) Medical											
(2) Surgical											
(3) Obstetrics											
(4) Gynecology											
(5) Other											
Dependents of Active Duty											
(6) Medical											
(7) Surgical											
(8) Obstetrics											
(9) Gynecology											
(10) Pediatrics											
(11) Other											
Retired											
(12) Medical											
(13) Surgical											
(14) Gynecology											
(15) Other											
Dependents of Retired											
(16) Medical											
(17) Surgical											
(18) Obstetrics											
(19) Gynecology											
(20) Pediatrics											
(21) Other											

- Step 13. Repeat Step 11 for the other two beneficiary categories

- Step 14. Repeat Steps 11 through 13 for surgical, obstetrics, gynecology, pediatrics and other patient stay patient types using the appropriate row in Exhibit III-11 and inserting the results in the appropriate cell of Exhibit III-12.

- Step 15. Insert the number in column (E) row (3) of Exhibit III-11 into column (c) rows (2), (4), (7), (9), (13), (14), (17), and (19) of Exhibit III-12.

- Step 16. Columns (D) through (I) of Exhibit III-12 are completed in a manner similar to Steps 11 through 14. That is multiply the coefficients of each department applicable to each patient type times the appropriate number in column (E) of Exhibit III-11.

- Step 17. Column (J) row (1) is merely the sum of row (1) columns (B) through (I). Complete column (J) by summing all columns along each row.

- Step 18. Column (K) is completed by entering the total number of patients served during the base year by class.

- Step 19. Column (L) is completed by dividing column (J) row (1) by column (K) row (1), then column (J) row (2) by column (K) row (2), then column (J) row (3) by column (K) row (3), etc. The results are the coefficients of the department of Linen Service applicable to all patient stay and delivery patient types.

- Step 20. Compute the coefficients of the department of Linen Service applicable to ambulatory clinic visit patient types. This computation is almost identical to Steps 11 through 19 except:

  - Columns (B), (C), (G), and (H) of Exhibit III-12 are unnecessary because these departments do not serve ambulatory clinic visit patient types

- The number entered into column (D) rows (1), (6), (12), (16) of Exhibit III-12 is the same number as in column (E) row (7) of Exhibit III-11. This is also true for surgical, gynecology, pediatrics, and other patient types and rows (8), (10), (11), and (12) respectively of Exhibit III-11.

There is an alternative to Steps 1 and 2 however. Some linen services maintain stock levels for each hospital department which use linen. These stock levels (in terms of total pieces of linen) aggregated into the categories identified in column (A) of Exhibit III-1, can replace the sampled data in column (B) of Exhibit III-11.

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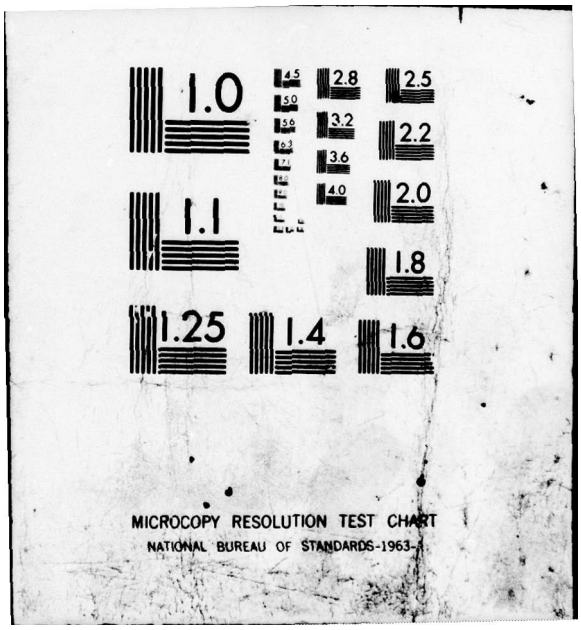
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1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

3.1.8 Coefficients for Medical Maintenance

The Medical Maintenance Department is a component of the Supply and Services (or Logistics) Division, and is responsible for repairing and/or disposing of equipment used in the hospital. Most departmental product centers (e.g., Pathology, Radiology, etc.) consume the services of the Medical Maintenance Department. Medical Maintenance is either scheduled Preventive Maintenance (PM), or non-scheduled Reactive Maintenance (RM). The specified departmental product output for Maintenance is jobs completed.

Like the department of Linen Service, the department of medical maintenance is an indirect product center. Therefore, the allocation of its products to specific patient types is performed using techniques similar to those used in Section 3.1.7. The specific steps in this procedure are as follows:

- Step 1. Collect the maintenance request registers for the base year period. Procedure: Obtain the Maintenance Request Register (DA 2405 at Exhibit III-13) from the Maintenance Office. The Maintenance Request Register records each job order requested from the Maintenance Department. Each job order request is recorded chronologically and numerically on a daily basis. The column of most importance on the Maintenance Request Register is column (c) "Work Requested By," which identifies the Departmental Product Center requesting the maintenance service.

- Step 2. Count the number of pages (DA 2405) in the register pertaining to job orders experienced during the base year and divide this number into 800 (the recommended sample size). The result, rounded upwards to the nearest integer, is the number of job orders per page that should be sampled in order to yield at least 800 observations. Example: assuming 170 pages, the resulting sample size per page is 5 job orders (800/170 = 4.71 rounded to 5)

Exhibit III-13

Example of a Maintenance Request Register

MAINTENANCE REQUEST REGISTER
(TM 38-750)

QUANTITY AND NOMENCLATURE b	WORK REQUESTED BY c	SERIAL OR USA REGISTRATION NUMBER d	BRIEF DESCRIPTION OF WORK, OR REMARKS e	DATE JOB ORDER RECEIVED f	DATE REPAIR		MAN-HOURS i	COST OF		TOTAL COST OF JOB l
					STARTED g	FINISHED h		LABOR j	PARTS k	

- Step 3. Randomly choose X numbers from 1 to 27, where X is the sample size per page determined in Step 2. Example: Chooose 5 numbers from 1 to 27. The result is the specific lines on each page of the Maintenance Request Register that will be sampled. Example: The five randomly chosen numbers from 1 to 27 are 3, 7, 9, 13, and 18. Therefore on each of the 170 pages the 3rd, 7th, 9th, 13th and 18th lines will be sampled.

- Step 4. From each line on each page determined in Step 3, record the department requesting the maintenance work from column C. A sample worksheet to record this data is found at Exhibit III-14.

- Step 5. Aggregate the data recorded in Step 4 into the categories identified in column (A) of Exhibit III-15. Put these aggregated data in column (B). Ignore maintenance requested by the departments of Medical Maintenance, Medical Materiel and Administration. Since the coefficients of these departments have not yet been calculated, it is not possible to allocate the maintenance used by these departments to patient types. There are two ways to account for maintenance provided these departments and both accomplish the same objective. One way is as above, ignore this maintenance. Another is to allocate this maintenance to each of the other departments in the ratios that the maintenance allocated to each department bears to the total of all maintenance sampled less the maintenance to these three. In the example assume that 12 requests from these three departments were filled. These would be allocated to each of the other departments in the ratio each bears to the total (9/838 x 12; 5/838 x 12; 16/838 x 12; etc.). But in projecting from column (B) to column (C) of Exhibit III-15, it can be shown that this allocation of the 12 will be accounted for without resorting to the above complication. Therefore, it is simpler to ignore the twelve.

Exhibit III-14

Worksheet Example

Departmental Product Centers	Reactionary Maintenance Hours	Jobs
Medical Ward	~~HHH~~ ~~HHH~~ ~~HHH~~ ///	18
Surgical Ward	~~HHH~~ ~~HHH~~	10
Operating Room	~~HHH~~ ////	9
Radiology	~~HHH~~	5
Pharmacy	~~HHH~~ ~~HHH~~ ~~HHH~~ /	16
Maintenance	~~HHH~~ //	7
Administration	//	2
Total		850

Exhibit III-15

Worksheet for the Allocation of Medical Maintenance Jobs Completed - I

(A) Department	(B) Sampled	(C) Total	(D) Products	(E) Jobs/Product
(1) Medical Hospitalization				
(2) Surgical Hospitalization I				
(3) Surgical Hospitalization II				
(4) OB/GYN Hospitalization				
(5) Pediatrics Hospitalization				
(6) Other Hospitalization				
(7) Medical Clinics				
(8) Surgical Clinics				
(9) Obstetrics Clinic				
(10) Gynecology Clinic				
(11) Pediatrics Clinic				
(12) Other Clinics				
(13) Radiology				
(14) Pathology				
(15) Food Service				
(16) Ambulance				
(17) Pharmacy				
(18) Other 1/				
(19) Total				

1/ Includes dental clinics, veternary services, satellite clinics, etc.

- Step 6. Sum column (B) (Example: 838)

- Step 7. Obtain from the Supplemental Med-302 reports (line 225), the total number of actual jobs completed during the base year. (Example: 4590)

- Step 8. Divide the number obtained in Step 7 by the number obtained in Step 6. This is a blowup factor to estimate the actual distribution of jobs completed among the departments from the sample distribution. (Example: 4590/838 = 5.477)

- Step 9. Complete column (C) of Exhibit III-15. This is accomplished by multiplying the numbers on each and every line of column (B) (9, 5, 16 etc.) by the blowup factor obtained in Step 8. The sum of column (C) should equal the number obtained in Step 7 (4590).

- Step 10. Complete column (D) with the total actual products of each department in column (A) during the base year (e.g. total medical bed days, CAP weighted units, etc.)

- Step 11. Divide column (C) row (1) by column (D) row (1) and enter the result in column (E) row 1. This number is the number of Medical Maintenance jobs completed per product output (bed day) of the department of Medical Hospitalization.

- Step 12. Repeat Step 11 for each row.

- Step 13. Multiply column (E) row (1) of Exhibit III-15 times the coefficient of the department of Medical Hospitalization applicable to active duty medical patient stay patient types. Insert the result in column (B) row (1) of Exhibit III-16. This result is the amount of products of the department of Medical Maintenance passing through the department of Medical Hospitalization to these patients.

Exhibit III-16

Worksheet for the Allocation of Medical Maintenance Jobs Completed II (Inpatient)

(A) Patient Type	(B) Bed Days	(C) Surgery	(D) Clinics	(E) Radiology	(F) Pathology	(G) Food Serv.	(H) Ambulance	(I) Pharmacy	(J) Total	(K) Patients	(L) Coefficients
Active Duty											
(1) Medical											
(2) Surgical											
(3) Obstetrics											
(4) Gynecology											
(5) Other											
Dependents of Active Duty											
(6) Medical											
(7) Surgical											
(8) Obstetrics											
(9) Gynecology											
(10) Pediatrics											
(11) Other											
Retired											
(12) Medical											
(13) Surgical											
(14) Gynecology											
(15) Other											
Dependents of Retired											
(16) Medical											
(17) Surgical											
(18) Obstetrics											
(19) Gynecology											
(20) Pediatrics											
(21) Other											

- Step 14. Repeat Step 13 for dependents of active duty by multiplying the number in column (E) row (1) times the coefficient of the department of Medical Hospitalization applicable to dependents of active duty medical patient stay patient types and insert the result in column (B) row (6) of Exhibit III-16.

- Step 15. Repeat Step 13 for the other two beneficiary categories.

- Step 16. Repeat Steps 13 through 15 for surgical, obstetrics, gynecology, pediatrics and other patient stay patient types using the appropriate row in Exhibit III-15 and inserting the results in the appropriate cell of Exhibit III-16.

- Step 17. Insert the number in column (E) row (3) of Exhibit III-15 into column (C) rows (2), (4), (7), (9), (13), (14), (17), and (19) of Exhibit III-16.

- Step 18. Columns (D) through (I) of Exhibit III-16 are completed in a manner similar to Steps 13 through 15. That is multiply the coefficients of each department applicable to each patient type times the appropriate number in column (E) of Exhibit III-15.

- Step 19. Column (J) row (1) is merely the sum of row (1) columns (B) through (I). Complete column (J) by summing all columns along each row.

- Step 20. Column (K) is completed by entering the total number of patients served during the base year by class.

- Step 21. Column (L) is completed by dividing column (J) row (1) by column (K) row (1), then column (J) row (2) by column (K) row (2), then column (J) row (3) by column (K) row (3) etc. The results are the coefficients of the department of Medical Maintenance applicable to all patient stay and delivery patient types.

- Step 22. Compute the coefficients of the department of Medical Maintenance applicable to ambulatory clinic visit patient types. This computation is almost identical to Steps 13 through 21 except:

- Columns (B), (C), (G), and (H) of Exhibit III-16 are unnecessary because these departments do not serve ambulatory clinic visit patient types.

- The number entered into column (D) rows (1), (6), (12), (16) of Exhibit III-16 is the same number as in column (E) row (7) of Exhibit III-15. This is also true for surgical, gynecology, pediatrics, and other patients types and rows (8), (10), (11), and (12) respectively of Exhibit III-15.

3.1.9 Coefficients for Medical Materiel

The Medical Materiel Department is also a component of the Supply and Services (or Logistics) Division. Its responsibilities include property management, storage, delivery, and supply. The departmental product output for Medical Material is the total number of requisitions processed. The Supply and Services Officer can furnish the total number of requisitions for the base year. The departmental product output for Medical Materiel, is allocated to each product center based on the number of requisitions consumed during the base year. The procedure for allocating the products of the department of Medical Materiel to each patient type is as follows:

- Step 1. Determine from the Supply and Services Office if the Supply System used by the medical facility can provide the number of requisitions used for each product center.

  If it can, record the data in column (B) of Exhibit III-17, skip Step 2 and go directly to Step 3. If the number of requisitions by product center is not available, it will be necessary to perform the calculations in Step 2.

- Step 2. This step assumes a relation between the dollar value of supplies and number of requisitions consumed in each product center. From the Comptroller or Management Services Officer, request the dollar value of supplies used by each department for the base year. This data is available from the "Status of Approved Operating Budget, CSCS FA 218." The elements of expense (EOE) 2610 and 2660 should be summed by AMS Codes. Record this data in column (C), Number of Requisitions, on the Schedule of Requisitions by AMS Product Center, Exhibit III-17. From the Supply and Services Officer request the total number of requisitions for the base year.

  Divide the total cost for supplies and equipment in the year by the total number of requisitions in the same year. This equals the average dollar value per requisition.

Exhibit III-17

Schedule of Requisitions
by AMS Product Center

(A) AMS CODE	(B) DEPARTMENT	(C) $ OF REQUISITIONS PER YEAR	(D) NUMBER OF REQUISITIONS
111	Admin - HQ	$ 4,419	584
112	Comptroller	93	12
113	Personnel	148	20
114	Patient Admin.	327	43
115	Plans & Operations	56	7
116	Troop Command	2,838	309
121	Department of Medicine	79,500	10,507
122	Department of Surgery	199,510	26,368
131	Department of Clinics	35,644	4,711
133	Phys. Med. Svc.	1,040	137
134	Social Work	39	5
135	Health & Environment	3,723	492
136	Family Practice	7,746	1,024
137	Mental Hygiene	443	58
141	Pathology	13,503	1,785
142	Radiology	18,290	2,417
143	Pharmacy	290,412	38,383
144	Medical Material	52,853	6,985
152	Linen	25,002	3,304
159	Non Pro Oncil	6,810	900
160	Food Service	62,932	8,318
	Total	$804,143	106,280[1]

[1] From Supply & Services Office

$$\frac{\$804,143}{106,280} = \underline{\$7.5662}$$

Now divide the dollar value of supplies and equipment for each AMS Product Center (column (C), Exhibit III-17) by the average dollar value per requisition (7.5662 in the example). This equals the number of requisitions used by each departmental cost center. Record these answers in column (D).

Step 3. Group the departments from departments by AMS Product Center to departmental product centers, column (B) Exhibit III-19. Care should be taken to ensure that all departments by AMS Code are included in the departmental product centers, e.g., Surgical Hospitalization II is composed of more than one AMS Product Center.

Also, sometimes the number of requisitions by AMS Product Center is not detailed sufficiently for study purposes. When this happens, the number of requisitions must be logically prorated. In this Example, the number of requisitions in the Department of Medicine had to be allocated to Medicine and Pediatrics. This is done by taking the number of patient days for Medicine in the base year and the number of patient days for Pediatrics in the base year and adding them together and computing the percentage of medicine and pediatric patient days. These percentages are then used to allocate the number of requisitions in the Department of Medicine to Medicine and Pediatrics. See Exhibit III-18. Allocations of the number of requisitions in the department of Surgery also need to be allocated, based on the percentage of patient days, to Surgery, OB, and GYN. (See Exhibit III-18.) Record these allocations on the worksheet at Exhibit III-19, column (B).

- Step 4. Unlike Medical Maintenance, it is necessary to allocate the requisitions used by the departments of Medical Materiel and Administration to the other departments. This obtains because unlike Medical Maintenance, a sample has not been taken (i.e., the universe is already known) and no blowup factor is used to account for these departments. Therefore (see Step 5 in Section 3.1.8) perform the following substeps:

Exhibit III-18

Allocations

Allocation of Medical and Pediatric Requisitions:

		%
Inpatient Days Medical:	12	12
Inpatient Days Pediatrics:	88	88
	100	

Total Number of Requisitions: 10507 = 100%

Medical: 1260 = 12%

Pediatric: 8247 = 88%

Allocation of Surgery, OB and GYN Requsitions:

	Days	%
Inpatient Days Surgical	136	68
OB	38	19
GYN	26	13
Total	200	100

Total Number of Requisitions: 26368

Requisitions for Surgical (68%) 17930

Requisitions for OB (19%) 5009

Requisitions for GYN (13%) 3429

Exhibit III-19

Worksheet for the Allocation of Medical Materiel Requisitions - I

(A) Department	(B) Sampled	(C) Total	(D) Products	(E) Requisitions/ Product
(1) Medical Hospitalization				
(2) Surgical Hospitalization I				
(3) Surgical Hospitalization II				
(4) OB/GYN Hospitalization				
(5) Pediatrics Hospitalization				
(6) Other Hospitalization				
(7) Medical Clinics				
(8) Surgical Clinics				
(9) Obstetrics Clinic				
(10) Gynecology Clinic				
(11) Pediatrics Clinic				
(12) Other Clinics				
(13) Radiology				
(14) Pathology				
(15) Food Service				
(16) Ambulance				
(17) Pharmacy				
(18) Other 1/				
(19) Total				

1/ Includes dental clinics, veternary services, satellite clinics, etc.

- Divide the number in column (B) row (22) of Exhibit III-19 by the number on line (19)

- Multiply the number obtained above by the number on row (1). Insert the result in column (c) row (1)

- Repeat the above step for column (B) rows (2) through (18). This results in a sum in column (C) row (19) equal to the sum in column (b) row (22). And the requisitions used by the departments of Administration and Medical Material are allocated to all other departments

- Step 5. Complete column (D) with the total actual products of each department in column (A) during the base year (e.g., Medical Hospitalization bed days, Pathology CAP weighted units, Food Service patient meals, etc.).

- Step 6. Divide column (C) row (1) by column (D) row (1) and enter the result in column (E) row (1). The result is the number of requisitions per product output (bed day) of the department of Medical Hospitalization.

- Step 7. Repeat Step 6 for each row.

- Step 8. Multiply column (E) row (1) of Exhibit III-19 times the coefficient of the department of Medical Hospitalization applicable to active duty medical patient stay patient types. Insert the result in column (B) row (1) of Exhibit III-20. This result is the amount of products of the department of Medical Materiel passing through the department of Medical Hospitalization to these patients.

- Step 9. Repeat Step 8 for dependents of active duty by multiplying the number in column (E) row (1) times the coefficient of the department of Medical Hospitalization applicable to dependents of active duty medical patient stay patient types and insert the result in column (B) row (6) of Exhibit III-20.

Exhibit III-20

Worksheet for the Allocation of Medical Materiel Requisitions-II (Inpatient)

(A) Patient Type	Departments											
	(B) Bed Days	(C) Surgery	(D) Clinics	(E) Radiology	(F) Pathology	(G) Food Svc.	(H) Ambulance	(I) Pharmacy	(J) Med.Maint.	(K) Total	(L) Patients	(M) Coefficients
Active Duty												
(1) Medical												
(2) Surgical												
(3) Obstetrics												
(4) Gynecology												
(5) Other												
Dependents of Active Duty												
(6) Medical												
(7) Surgical												
(8) Obstetrics												
(9) Gynecology												
(10) Pediatrics												
(11) Other												
Retirees												
(12) Medical												
(13) Surgical												
(14) Gynecology												
(15) Other												
Dependents of Retirees												
(16) Medical												
(17) Surgical												
(18) Obstetrics												
(19) Gynecology												
(20) Pediatrics												
(21) Other												

- Step 10. Repeat Step 8 for the other two beneficiary categories.

- Step 11. Repeat Steps 8 through 10 for surgical, obstetrics, gynecology, pediatrics and other patient stay patient types using the appropriate row in Exhibit III-19 and inserting the results in the appropriate cell of Exhibit III-20.

- Step 12. Insert the number in column (E) row (3) of Exhibit III-19 into column (C) rows (2), (4), (7), (9), (13), (14), (17), and (19) of Exhibit III-20.

- Step 13. Columns (D) through (J) of Exhibit III-20 are completed in a manner similar to Steps 8 through 11. That is multiply the coefficients of each department applicable to each patient type times the appropriate number in column (E) of Exhibit III-19.

- Step 14. Column (K) row (1) is merely the sum of row (1) columns (B) through (J). Complete column (K) by summing all columns along each row.

- Step 15. Column (L) is completed by entering the total number of patients served during the base year by class.

- Step 16. Column (M) is completed by dividing column (K) row (1) by column (L) row (1), then column (K) row (2) by column (L) row (2), then column (K) row (3) by column (L) row (3) etc. The results are the coefficients of the department of Medical Materiel applicable to all patient stay and delivery patient types.

- Step 17. Compute the coefficients of the department of Medical Materiel applicable to ambulatory clinic visit patient types. This computation is almost identical to Steps 8 through 16 except:

  - Columns (B), (C), (G), and (H) of Exhibit III-19 are unnecessary because these departments do not serve ambulatory clinic visit patient types

- The number entered into column (D) rows (1), (6), (12), (16) is the same number as in column (E) row (7) of Exhibit III-19. This is also true for surgical, gynecology, pediatrics, and other patient types and rows (8), (10), (11), and (12) respectively of Exhibit III-19.

3.1.10 Coefficients for Administration

Administration provides command, control, staffing and financial management to the hospital.

For purposes of this study, Administration is composed of:

- Management Services (Comptroller) Division
- Office of the Chief, Supply and Services (Logistics) Division
- Patient Administration Division (PAD)
  - Admissions and Dispositions
  - Clinical Records and Reports
  - Medical Transcribing
  - Outpatient Records
  - Hospital Treasurer
  - Chief, PAD
- Chaplain Division
- Central Materiel Service (CMS)
- Adjutant - including:
  - Reproduction
  - Mail Room
- Chief, Nursing Service
- Plans, Operations and Training Division (PO&T)
- Medical Company

The administrative sections of Adjutant, Mail Room PO&T, Chief, Nursing Service, Chief, PAD, and Medical Company are only indirectly sensitive to patients served and are treated elsewhere

in this methodology. The remaining sections however, have coefficients associated with each. The techniques for constructing these coefficients are described in the following paragraphs.

Admissions and Dispositions, and Clinical Records and Reports. The product outputs of each of these sections is dispositions. Since each patient stay and delivery patient type always requires one disposition and one only per episode of care, the coefficients of these sections applicable to each patient stay and delivery patient type is a constant number, one (1.0).

Outpatient Records. The product output of this section is clinic visits. However, clinic visits by active duty beneficiaries are not included. Therefore, no coefficients of this section are usually applicable to active duty patient types. Also there are certain clinics, visits to which do not require the services of this section. Such clinics often include (but may not in particular hospitals):

- Allergy Clinic
- Physical Therapy Clinic
- Occupational Therapy Clinic
- Obstetrics Clinic
- Community Health Nurse
- Mental Hygiene Clinic
- Social Work Service
- Family Practice Clinic (if this clinic maintains its own medical records)

From the latest manpower survey of the hospital, determine if all other-than-active duty ambulatory clinic visits were included in the workload base of the Outpatient Records Section. If so, the coefficients of this section applicable to other-than-active duty ambulatory clinic visit patient types is a constant one (1.0) except for obstetrics patient types. That is, each visit regardless of service or beneficiary requires one product output of this section. In the case of obstetrics

patient types however, the coefficient of this section applicable to these patient types would be identical to the coefficients of the department of OB/GYN Clinics applicable to each obstetrics delivery patient type. If visits to some clinics are excluded, perform the following step:

- Step 1. If Allergy clinic visits are excluded, subtract from 1.0 the coefficient of the Allergy Clinic applicable to dependents of active duty medical ambulatory clinic visit patient types. The result is the coefficient of the administrative section, Outpatient Records, applicable to this patient class.

- Step 2. Repeat Step 1 for the other two beneficiary classes.

- Step 3. Repeat Steps 1 and 2 for surgical ambulatory clinic visit patient types and the coefficients of the Physical Therapy and Occupational Therapy Clinics.

- Step 4. Repeat Steps 1 and 2 for other ambulatory clinic visit patient types and the excluded component clinics of the department of Other Clinics.

- Step 5. If obstetrics clinic visits are excluded, the coefficients of this section applicable to obstetrics delivery patient types will be zero regardless of beneficiary.

Medical Transcribing. The product output of this administrative section is pages typed. A simplifying assumption is made that these pages typed are applicable only to patient stay and delivery patient types. The procedure used to calculate the coefficients of this section is as follows:

- Step 6. Determine from the Supplemental Med-302 report (line 206) the total number of pages typed during the base year.

- Step 7. Divide the number obtained in Step 6 by the total number of bed days spent by all patient stay and delivery patient types regardless of service or beneficiary during the base year. The result is the number of pages typed per bed day.

- Step 8. Multiply the constant obtained in Step 7 by the coefficient of the department of Medical Hospitalization applicable to active duty medical patient stay patient types. The result is the coefficient of this administrative section applicable to this patient type.

- Step 9. Repeat Step 8 for dependents of active duty medical patient stay patient types.

- Step 10. Repeat Step 8 for the other two beneficiary categories.

- Step 11. Repeat Steps 8 through 10 for surgical, gynecology, pediatrics, and other patient stay, and obstetrics delivery patient types; using the coefficients of the departments of Surgical, Surgical Pediatrics, Other (or Medical) and OB/GYN Hospitalization respectively.

Chaplain. The product output of this section is occupied beds. As pertains to particular patients, this coefficient is identical to the coefficients of the hospitalization departments. That is the coefficient of the department of Medical Hospitalization applicable to active duty medical patient stay patient types is identical to the coefficient of the Chaplain division applicable to the same patient type. The same is true for the coefficient of the department of Surgical Hospitalization I and active duty surgical patient stay patient types.

Reproduction. The product output of this administrative section is impressions. A simplifying assumption is made that these impressions are applicable only to patient stay and delivery patient types. The procedure used to calculate the coefficients of this section is as follows:

- Step 12. Determine from the Supplemental Med-302 report (line 201) the total number of impressions during the base year.

- Step 13. Divide the number obtained in Step 12 by the total number of bed days spent by all patient stay and delivery patient types regardless of service or beneficiary during the base year. The result is the number of impressions per bed day.

- Step 14. Multiply the constant obtained in Step 13 by the coefficient of the department of Medical Hospitalization applicable to active duty medical patient stay patient types. The result is the coefficient of this administrative section applicable to this patient type.

- Step 15. Repeat Step 14 for dependents of active duty medical patient stay patient types.

- Step 16. Repeat Step 14 for the other two beneficiary categories.

- Step 17. Repeat Steps 14 through 16 for surgical, gynecology, pediatrics, and other patient stay, and obstetrics delivery patient types; using the coefficients of the departments of Surgical, Surgical Pediatrics, Other (or Medical) and OB/GYN Hospitalization respectively.

Hospitalization Treasurer, Comptroller, Chief Logistics, CMS. These four administrative sections are treated together because the specified product outputs are identical and the coefficients of these sections applicable to each patient type are identical across all four. The specified product output is the Medical Care Composite Unit (MCCU). From the method used to calculate the MCCU, the following information was derived:

- Each patient stay patient type contributes toward a monthly MCCU at the rate expressed as

$$\frac{X}{30} + .3333$$

where X equals bed days per patient type

- Each delivery type contributes toward a monthly MCCU at the rate expressed as:

$$\frac{X}{30} + .3333 + \frac{Y}{3} + Z\ (.01)$$

where X equals bed days per patient, Y equals live births per obstetric patient, and Z equals the coefficient of the department of OB/GYN clinics applicable to an obstetrics patient

- Each ambulatory clinic visit patient type contributes toward a monthly MCCU at the rate of .01

To construct the coefficients of this section use the following techniques:

- Step 18. Divide the coefficient of the department of Medical Hospitalization applicable to active duty medical patient stay patient types by 30. Add to this the number, .3333. The result is the coefficients of these four sections applicable to active duty medical patient stay patient types.

- Step 19. Repeat Step 18 for dependents of active duty medical patient stay patient types.

- Step 20. Repeat Step 18 for the other two beneficiary categories.

- Step 21. Repeat Steps 18 through 20 for surgical and gynecology, pediatrics, and other patient stay patient types; using the coefficients of the departments of Surgical, Surgical Pediatrics and Other (or Medical) Hospitalization respectively.

- Step 22. Obtain from the facility or IPDS the total number of live births experienced during the base year. Divide this number by the total number of obstetrics patients during the same period.

- Step 23. Repeat Step 18 for active duty obstetrics delivery patient types and the department of OB/GYN Hospitalization.

- Step 24. Divide the number obtained in Step 22 by 3 and add this dividend to the number obtained in Step 23.

- Step 25. Multiply the coefficient of the department of OB/GYN clinics applicable to an active duty obstetrics delivery patient type by .01. Add this product to the number obtained in Step 24. The result is the coefficients of these four administrative sections applicable to active duty obstetrics delivery patient types.

- Step 26. Repeat Steps 23 through 25 for the other beneficiary categories.

It is of course true that some of these administrative sections provide services which can not be attributable to patients of the hospital. For example, both the Management Services Division and the Chief, Supply and Services Division support the Veterinary Activity which department is not considered in this methodology. It is most accurate, therefore, to discriminate the product outputs of the above departments between that which can be attributed to hospital patients and that which can be attributed to other MEDDAC activities. In practice, however, this is not possible. The effects of this minor loss in accuracy is mitigated by the nature of the product output measures. Although these administrative sections provide services to other than hospital patient care departments, these services are either not used to determine staffing requirements or are already accounted for in the measures themselves. Therefore, the effects of this minor loss in accuracy can be considered insignificant.

Exhibit III-21 is an example of coefficients of the department of Administration.

Exhibit III-21

Example of Coefficients of the Department of Administration for a Specific Hospital

PATIENT TYPES			ADMINISTRATION									
BENEFICIARY			A&D	Clin. Recds	O/P Recds	Med. Trans.	Treas.	Compt.	Chief S&S	Chap.	CMS	Repro
RETIRED	Medical	Patient Stay	1.0	1.0	-	2.761	.613	.613	.613	8.4	.613	.3
		Ambulatory Clinic Visits	-	-	1.0	-	.01	.01	.01	-	.01	-
	Surgical	Patient Stay	1.0	1.0	-	2.103	.547	.547	.547	6.4	.547	.228
		Ambulatory Clinic Visits	-	-	.927	-	.01	.01	.01	-	.01	-
	Gynecology	Patient Stay	1.0	1.0	-	.657	.400	.400	.400	2.0	.400	.071
		Ambulatory Clinic Visits	-	-	1.0	-	.01	.01	.01	-	.01	-
	Other	Patient Stay	1.0	1.0	-	-	-	-	-	-	-	-
		Ambulatory Clinic Visits	-	-	-	-	.01	.01	.01	-	.01	-
DEPENDENTS OF RETIRED AND SURVIVORS	Medical	Patient Stay	1.0	1.0	-	2.978	.635	.635	.635	9.06	.635	.323
		Ambulatory Clinic Visits	-	-	.912	-	.01	.01	.01	-	.01	-
	Surgical	Patient Stay	1.0	1.0	-	1.696	.505	.505	.505	5.16	.505	.184
		Ambulatory Clinic Visits	-	-	.771	-	.01	.01	.01	-	.01	-
	Obstetrics	Deliveries	1.0	1.0	-	1.275	.850	.850	.850	3.88	.850	.138
	Gynecology	Patient Stay	1.0	1.0	-	1.518	.487	.487	.487	4.62	.487	.165
		Ambulatory Clinic Visits	-	-	1.0	-	.01	.01	.01	-	.01	-
	Pediatrics	Patient Stay	1.0	1.0	-	.940	.429	.429	.429	2.86	.429	.102
		Ambulatory Clinic Visits	-	-	1.0	-	.01	.01	.01	-	.01	-
	Other	Patient Stay	1.0	1.0	-	-	-	-	-	-	-	-
		Ambulatory Clinic Visits	-	-	-	-	.01	.01	.01	-	.01	-

3.2 CONSTRUCTING THE DEPARTMENTAL TABLES

These tables reflect the resources required to produce the specified product outputs of each department. Specifically, they detail the product output levels which may be produced by a given complement of personnel and equipment resources. The tables are organized to illustrate each level at which an additional resource must be acquired to increase product output beyond that level. These levels are termed the constraint points of the department. That is, the product output of the department is constrained at each constraint point due to the insufficiency of resources.

There is at least one table for each of the departments identified in the Table of Coefficients. Specifically these are:

- Medical Hospitalization
- Surgical Hospitalization
  - Surgical Hospitalization I
  - Surgical Hospitalization II
- OB/GYN Hospitalization
- Pediatrics Hospitalization
- Other Hospitalization
- Medical Clinics - one table for each component clinic
- Surgical Clinics - one table for each component clinic
- OB/GYN Clinics
- Pediatrics Clinics
- Other Clinics-one table for each component clinic
- Radiology
- Pathology
- Pharmacy

- Food Service
- Linen
- Ambulance
- Medical Maintenance
- Medical Material
- Administration (one table for each section)

In addition, one table must be constructed for each physician type (e.g., medical physicians, surgeons, obstetrician/gynecologist) to account for the tradeoffs between inpatient and outpatient care which may be provided by physicians.

General Technical Approach

The basis for the construction of the personnel resource departmental tables is the Staffing Guide for U.S. Army Medical Department Activities (DA Pamphlet 570-557, 26 June 1974). The tables, therefore, are constructed around the personnel resource constraints. In general, the staffing guide is a reasonable basis because it is used (albeit as a guide) in determining the personnel requirements in each department at every U.S. Army Hospital. Further, the staffing guide tables are based on measures of the workload of each department, which measures are often comparable to the specific product outputs of the departments in the Table of Coefficients.

In this section, the general approach to using the staffing guide tables to determine personnel resource constraint points is delineated. In the sections that follow, the specific modifications of the staffing guide tables required to equate these with the specified hospital departmental tables are detailed.

Exhibit II-8 is an example of a departmental table. As may be seen, each product output level at which an additional resource is required to increase product outputs of the department beyond that level is identified. Now consider the staffing guide table (using radiology as an example) at Exhibit III-22. As may be seen in this latter exhibit, the staffing guide merely delineates the specific workload measure levels at

Exhibit III-22

The Staffing Guide Table for Radiology

Table 557-61: Radiology

Work Performed. Provides diagnostic and therapeutic radiological services as required in the examination, care and treatment of patients.

Yardstick					
Examinations (thousands) *	4	6	11	30	40
Manpower requirement	6	10	18	34	52
Interval rate	*2.0*	*1.6*	*.84*	*.8*	

	Military positions					Number of positions					*Civilian positions*	
Line	Duty position title	BR	MOS code	Grade	Position delineation						Job title	Code
1	CHIEF RADIOLOGY [a]	MC	3306	LTC/MAJ	M	1	1	1	1	1		
2	RADIOLOGIST	MC	3306	MAJ/CPT	C	..	1	1	2	2	MED OFF (GEN RADL)	GS-602
3	CH X-RAY SP	NC	91P40	E-7	C			1	1	1	MED RADL TECH.	GS-647
4	CH X-RAY SP	NC	91P40	E-6	C	1	1	..	..	..	MED RADL TECH.	GS-647
5	ASST CH X-RAY SP.	NC	91P40	E-6	C	..	..	..	1	1	MED RADL TECH.	GS-647
6	*SR STENOGRAPHER.*	..	71C30	E-5	C	1	1	1	1	1	CLERK STENO CLERK DIC MACH TNSBR.	GS-312 GS-316
7	X-RAY SPECIALIST.	..	91P20	E-5	C	1	2	5	9	12	MED RADL TECH.	GS-647
8	SENIOR CLERK	..	71B20	E-4	C	..	..	..	..	1	CLERK	GS-301
9	CLERK TYPIST	..	71B30	E-4	C	1	1	1	2	2	CLERK TYPIST	GS-322
10	X-RAY ASSISTANT.	..	91P20	E-4	C	1	1	4	9	12	MED RADL TECH.	GS-647
11	CLERK	..	71B10	E-3	C	..	1	2	2	2	CLERK	GS-301
12	X-RAY ATTENDANT.	..	91P20	E-3	C	..	1	2	5	7	MED RADL TECH.	GS-647

*Total X-ray exposures and fluoroscopic examinations performed during the calendar month (ten separate exposures taken during a GI series will count as ten examinations; three exposures of a foot, even though on one sheet of film, will count as three work units).

[a] Acts as Chief of Radiology Service.

Note 1. Manpower requirement reflected within this table may be reduced by local appraisal if the X-ray machines can use roll film.

Note 2. Where service operates other than 40 hours a week, manpower requirements will be determined by local appraisal.

Table 557-62: Nuclear Medicine

Work Performed. Performs diagnostic and therapeutic service through the use of radioisotopes.

Yardstick *					

	Military positions				Position delineation	*Civilian positions*	
Line	Duty position title	BR	MOS code	Grade		Job title	Code
1	CH NUCLEAR MEDICINE	MC	3004	LTC/MAJ	C	MED OFF (GEN RADL)	GS-602
2	CLIN NUCLEAR MED SP	..	[a]	[a]	C	MED RADL TECH	GS-647
3	CLERK TYPIST	..	71B20	E-4	C	CLERK TYPIST	GS-322

*This [illegible] will be established by direction of the Office of The Surgeon General. Manpower requirements will be [illegible] by local appraisal. Positions shown indicate the type of personnel which may be required.

[a] MOS Codes and grades for these positions are being developed and will be included in the staffing tables when approved. In the interim, MOS Code 000 may be used to identify applicable positions in accordance with provisions of AR 611-201.

which the interval rates change (the interval rate determines the staffing needs for each unit of workload measure, i.e., when the interval rate is 2.0, two persons are needed for each 1000 examinations). Therefore, between workloads of 4000 and 6000 examinations, four people are added and between 6,000 and 11,000 examinations, eight people are added. but it is unknown, from the table, at which point each person (resource) is added. Furthermore, it is unclear in the staffing guide which resource (X-ray attendant, clerk, X-ray specialist, radiologist, etc.) is specifically added at each point.

Therefore, certain assumptions were made which include:

- Assumption 1. An individual resource is required when the workload measure (yardstick) yields a requirement for an extra .5 person. That is, for example, if the workload measure times the interval rate yields 6.5 manpower requirements, a seventh resource is added and the eighth will not be added until the workload requires 7.5 resources.

- Assumption 2. Officers and enlisted personnel are added separately. That is, between two columns of the staffing guide, a certain number of officers and a certain number of enlisted men are added as the workload increases. Which are added when depends on the ratio of added officers to added enlisted. Each class of personnel resource is added according to this ratio. If the ratio is two officers to four enlisted (1:2), two enlisted are added first, then an officer, then two enlisted, then an officer.

- Assumption 3. In general, and except for the above, personnel resources are added in the order, lowest grade individual first to highest grade individual. Where more than one individual resource at a certain grade is added, one will be added following the lowest to highest order until all levels in the table have been accounted for, then return to the bottom of the table adding the second resource at each level. In the example of radiology, consider the column corresponding to a manpower requirement of 34. When adding personnel between 11 and 30 thousand examinations, add one X-ray attendant (E-3), one X-ray assistant (E-4), one clerk

typist (E-4) up to the Assistant Chief X-ray Specialist. Then return to add a second X-ray attendant (E-3), a second X-ray assistant (E-4), etc. Keep returning to the bottom of the table until the 34th resource is added (i.e., when the interval rate times the workload measure yields a manpower requirement of 33.5).

- Assumption 4. Where the workload (and consequently manpower requirement) yields an upgrade of a position, that upgrade will be reflected at the point the last person in a staffing guide column is added. Again in the example, the upgrade of the Chief X-ray Specialist from E-6 to E-7 is reflected at the same product output level that yields a requiement for the 18th (i.e., at 17.5) resource.

The steps to be used in developing a departmental table using the above assumptions are as follows:

- Step 1. Determine the staffing guide table appropriate to the department in question.

- Step 2. Determine the first resource and product output level of the department. This is the first column of the staffing guide table.

- Step 3. Consider the equation:

$$Y = I (X-B) + M$$

where:

Y = Manpower Requirement

I = Interval rate

X = Product output

B = Product output at base

M = Manpower requirement associated with the base product output (B).

This is the equation used by members of the manpower survey team to determine manpower requirements at given levels of workload. Since from Assumption 1, the manpower requirement is known, the construction of the departmental tables requires the solution for X associated with each Y. The staffing guide identifies I, B and M. Assumption 1 says that Y is an independent variable of some integer plus .5. Therefore, to solve for X, consider the equation:

$$X = \frac{Y - M + IB}{I}$$

Which states that the product output level for each manpower requirement equals that requirement minus the manpower requirement (M) associated with a base product output level (B) plus the product of the interval rate (I) and the base product output level (B), all divided by the interval rate (I). By substituting increasing manpower levels for Y in this equation, one can determine the various dependent variables X. In a staffing guide table, however, the interval rate (I) changes over product output levels. As this variable changes, the variables M and B also change. This fact leads to a different equation each time the interval rate changes. In this step, therefore, determine the product output levels associated with increasing manpower levels for the highest interval rate. In the radiology example, this means determine the product output levels associated with manpower requirements of 6.5, 7.5, 8.5 and 9.5 (the last is the point where the tenth person is added and the interval rate changes) where I = 2.0, M = 6, B = 4 and X is in terms of thousands of examinations. Substituting the four levels of Y into the equation, the associated X's are 4.25, 4.75, 5.25, 5.75.

- Step 4. Determine the ratio of officers to enlisted added between product outputs determined in Step 3 (1 to 3).

- Step 5. Allocate the personnel added, to the product output levels determined in Step 5 according to assumptions 2, 3, and 4.

- Step 6. Repeat Step 3 for the next highest interval rate (1.6 in the example).

- Step 7. Repeat Steps 4 and 5 for the product output levels determined in Step 6.

- Step 8. Repeat Steps 3, 4 and 5 for all other interval rates.

- Step 9. Now that the staffing guide table is expanded from a base of 4,000 examinations up through 40,000, it is necessary to work backwards to 0 product output. The resources at 0 product output can then be considered the minimum staffing level required to merely open the department. This is accomplished by merely substituting for Y in the form of the equation used in Step 3, the numbers 5.5, 4.5, 3.5, 2.5, 1.5, in order until the calculated value of X reaches zero or less.

- Step 10. If 1.5 is substituted without reaching zero product output, then the value of X is the constraint on one resource in the department (1,750 examinations or 1.5 resources in the example). It is not considered meaningful to delineate less than one personnel resource in each department of the hospital. If zero product output is reached before substituting 1.5 for Y in the equation, i.e. Y - M + IB is zero or negative, (assume 4.5 persons = -100 examinations), the first constraint point in the table is the value of X for the Y which yields the last positive number (assuming 4.5 persons yields a value of X of -100 examinations and 5.5 yields a value of X of + 100 examinations, the first constraint point is 100 examinations). The resources associated with zero product output (i.e. the base resource level) are the Y - .5th number of resources associated with the Y which yields the last positive value of X (continuing the above assumption, since 5.5 = Y is the last value of Y yielding a positive value of X, the base level of resources associated with zero product output level is 5.5 - .5 = 5)

- Step 11. Determine the personnel associated with zero product output determined in Step 10. For this calculation, Assumption 2 is ignored and Assumption 3 is turned around. Instead it is assumed that within the first staffing guide column, the officers are most important and the last to be subtracted. Therefore moving from the first constraint point identified in Step 3 and moving backward to zero product output, subtract one resource from the lowest grade to the highest, exhausting all enlisted resources first, then officer resources until the number of remaining resources equals the number obtained in Step 10. These remaining resources are the base level associated with zero product output.

- Step 12. Determine the resources associated with the constraint points identified in Step 9. Reversing the direction taken in Step 11, the resource associated with the first constraint above zero is the last resource subtracted in Step 11. The resource associated with the second constraint above zero is the second to last subtracted in Step 11. Continue thus process until all resources are accounted for.

The result of Steps 1 through 12 is a personnel resource departmental table starting from a base resource level associated with zero departmental product outputs through the highest level of product outputs in the staffing guide tables. It is also possible to build a departmental table which goes beyond this level. This is accomplished by assuming that the next column in the staffing guide is exactly double the last. In the example at Exhibit III-22, this means that the sixth column pertains to a manpower requirement of 84 resources distributed in the same way as the 42 (e.g. 14 X-ray attendants, 4 clerks, 24 X-ray assistants, 4 Clerk Typists, 2 Senior Clerks, 24 X-ray specialists, etc.). Then continue to build the table as in Steps 3, 4, and 5.

3.2.1 Medical Hospitalization

To construct this table, follow the General Technical Approach to expand the staffing guide table pertaining to the Medical Nursing Unit of the department of Nursing. Two modifications of this expanded table are necessary, however. First, the staffing guide is based on average daily patient beds occupied as a workload measure. Because the decision frame for using this model is one month, the measure, average daily beds occupied, must be converted to average monthly beds occupied. This is accomplished by simply multiplying each workload level in the expanded table by 30 to yield product output levels in terms of bed days per month.

If the hospital also has a medical intensive care unit (and/or a coronary care unit) a separate departmental table for this section must be constructed. This is accomplished by merely expanding the staffing guide table pertaining to the Intensive Care Unit as in the General Technical Approach and multiplying each product output constraint by 30 to yield monthly constraints.

3.2.2 Surgical Hospitalization

The departmental table for Surgical Hospitalization I (nursing wards) is constructed exactly as Medical Hospitalization but using the staffing guide table for the Surgical Nursing Unit.

Surgical Hospitalization II however is composed of four tables: operating room, recovery room, anesthesia nursing and anesthesiologists. These tables are constructed as follows:

- Step 1. Expand the staffing guide table for Operating Room Nursing as in the General Technical Approach.
- Step 2. Expand the staffing guide table for Anesthesiology Nursing as in the General Technical Approach.
- Step 3. Expand the staffing guide table for Post Anesthesia/Recovery Nursing Unit as in the General Technical Approach.
- Step 4. Multiply the constraint levels determined in Step 3 by 30.
- Step 5. The departmental table for Anesthesiologists is constructed by using the stated requirements of one anesthesiologist for 100 episodes of surgery and two for 300 or more (i.e. the constraint on one anesthesiologist is 200 episodes of surgery.

If the hospital also has a Surgical Intensive Care Unit, a separate table for this section (of Surgical Hospitalization I) must also be constructed. This is accomplished as in Medical Hospitalization by expanding the staffing guide table for the Intensive Care Unit as in the General Technical Approach and multiplying each constraint point by 30.

3.2.3 OB/GYN Hospitalization

Because gynecology patients require the product outputs of the department of Surgical Hospitalization rather than OB/GYN Hospitalization (except for physicians). The construction of this departmental table, therefore, is based on the nursing services required by obstetrics patients. Like the table for Surgical Hospitalization II, the table for OB/GYN Hospitalization requires more than one (i.e. three) staffing guide tables. These are modified as follows:

- Step 1. Expand the staffing guide table for Obstetrics (Ante/Post Partum) Nursing Unit as in the General Technical Approach.
- Step 2. Multiply all product output levels determined in Step 1 by 30 to project the expanded staffing guide table to monthly product outputs.
- Step 3. Repeat Steps 1 and 2 for the staffing guide table for Nursery.
- Step 4. Determine the ratio of total newborn's bed days spent in the hospital during the base year to obstetrics patient's total bed days spent in the hospital during the base year.
- Step 5. Divide the ratio obtained in Step 4 into each product output level determined in Step 3. This calculation equates nursery bed days to obstetric patient bed days. The ratio obtained in Step 4 should be close to one (1) but not exactly as certain obstetrics patients have multiple births and others are admitted under the obstetrics clinic service but not for the purpose of delivering babies.
- Step 6. Expand the staffing guide table for Obstetrics (Labor/Delivery) Nursing Unit as in the General Technical Approach.
- Step 7. From the facility and/or IPDS data calculate the ratio of total obstetrics bed days (spent by all obstetrics delivery patient types) during the base year to total live births during the same period.

- Step 8. Multiply the ratio obtained in Step 7 times each constraint point determined in Step 6. The result is a departmental table for Labor and Delivery in terms of OB/GYN product outputs (i.e., bed days).

3.2.4 Pediatrics Hospitalization

This departmental table is constructed exactly as the departmental tables for Medical Hospitalization and Surgical Hospitalization I. That is, expand the staffing guide table for Pediatric Nursing Unit and multiply each product ouptut level by 30.

3.2.5 Other Hospitalization

This table is constructed exactly as the departmental tables for Medical Hospitalization and Surgical Hospitalization I. That is, expand the staffing guide table for Psychiatric Nursing Unit, and multiply each product output level by 30.

3.2.6 Medical Clinics

The construction of this table (or tables) merely requires the expansion of the staffing guide tables as in the General Technical Approach for each of the medical clinics. These clinics are:

- Medical (Internal Medicine)
- Dermatology (include dermatologists as they are not expected to provide inpatient care)
- General Outpatient (include physicians)
- Immunization

This departmental table may be constructed as one table with the product output levels (in clinic visits) in one column and a separate column for each component clinic, or as separate tables for each clinic.

3.2.7 Surgical Clinics

In general the construction of this table merely requires the expansion of the staffing guide tables, as in the General Technical Approach, for each of the surgical clinics. These include:

- Surgical
- Urology
- Otorhinolaryngology (include physicians)
- Opthalmology
- Optometry
- Physical Therapy
- Occupational Therapy
- Emergency Treatment Room (include physicians)

The orthopedic clinic is a special case. First, the staffing guide table does not delineate nursing support resources for this clinic. Therefore information in the manpower survey must be used to construct this table. Generally, the manpower survey identifies an average monthly number of clinic visits and a specific number of nursing personnel to support those visits. The number of clinic visits divided by the number of personnel is a useful interval rate to construct the departmental tables as in the General Technical Approach.

Furthermore, the orthopedic clinic includes two subsections: cast room and brace shop. Each of these tables may be constructed as follows:

- Step 1. Expand the staffing guide tables for Cast Room and Brace Shop as in the General Technical Approach.
- Step 2. From the manpower survey identify the average number of casts placed per month.

- Step 3. Divide the average monthly orthopedic clinic visits (also from the manpower survey) by the number obtained in Step 2.

- Step 4. Multiply the ratio obtained in Step 3 times each constraint level in the Cast Room departmental table obtained in Step 1. The result is a Cast Room departmental table in terms of orthopedic clinic visits.

- Step 5. Repeat Step 2 for the Brace Shop and appliances.

- Step 6. Repeat Step 3 for the Brace Shop.

- Step 7. Repeat Step 4 for the Brace Shop. The result is a Brace Shop departmental table in terms of orthopedic clinic visits.

3.2.8 OB/GYN Clinics

The construction of this table merely requires the expansion of the staffing guide table, Obstetric-Gynecology Clinic, according to the General Technical Approach.

3.2.9 Pediatrics Clinics

The construction of this table merely requires the expansion of the staffing guide table, Pediatrics Clinic, according to the General Technical Approach. Include the physicians in constructing this table, however, as the requirements for pediatricians in the clinic account for inpatient support to the newborn nursery and pediatrics ward.

3.2.10 Other Clinics

In general the construction of this table merely requires the expansion of the staffing guide tables, according to the General Technical Approach, for each of the "other" clinics. These include:

- Army (or Community) Health Nurse
- Social Work Service
- Mental Hygiene Consultation Service (include psychiatrists and psychologists where no inpatient psychiatric nursing wards exist)

This departmental table may be constructed as one table with the product output levels (in clinic visits) in one column and a separate column for each component clinic, or as separate tables for each clinic.

3.2.11 Physicians

Separate departmental tables for physicians which can be used to determine the constraints on these resources independent of the clinics and the hospitalization departments to which physicians are actually assigned must be constructed. It has been found that all physicians (except anethesiologists) actually provide care through the component clinics of the clinics departments. This obtains even if a physician is assigned to an inpatient position on the Table of Distribution and Allowances (TDA). However, the patients defined by the service measure, patient stay, also require the services of physicians. The issue here is that all physicians provide their services to patient stay, delivery and ambulatory clinic visit patient types and not exclusively to any one or two patient types.

However, the staffing guide separates inpatient requirements from outpatient requirements. That is, certain levels of product output of hospitalization departments yield requirements for physicians; and certain levels of product outputs of clinics departments yield requirements for the same types of physicians. For example, a product output of the department of Medical Hospitalization of 1200 bed days per month yields a requirement for one Internist. At the same time a product output of the component clinic Internal Medicine, of the department of Medical Clinics of 300 clinic visits also yields a requirement for one Internist. If 1200 bed days and 300 clinic visits are produced, then the hospital should have two Internists, though the two would each work in both the Internal Medicine Clinic and on the medical ward.

Suppose the workload in the Internal Medicine Clinic rose to 455 clinic visits per month but no increase in the bed days produced was experienced. On the basis of the staffing guide measures alone, this increase would yield the requirement for an additional Internist (.00333 (455-300) + 1 = 1.52 which is rounded to 2). In practice, however, there already are two physicians in the clinic, though each is providing inpatient services as well as outpatient services. Taken together then, instead of one physician working 1.52 times as much as he is thought to have the capacity (in the clinic) and one working at 1.0 of his capacity (in the ward), each is working only 1.26 times his capacity. On this basis, another Internist is not required. The physician departmental tables account for these situations.

In order to be useful, the physician departmental tables must be constructed in terms of one homogenous product output measure. These are specified as follows:

- Medical Physicians - Internal Medicine Clinic Visits (300)
- Surgical/Physicians - Surgery Clinic Visits (450)
- OB/GYN Physicians - Gynecology Clinic Visits (400)
- Other Physicians (Psychiatrists) - Psychiatry Clinic Visits (125)

Inpatient workload measures and outpatient measures for different types of physicians within these broad classes will then be converted to this product output. The conversion techniques are discussed in Chapter IV. The procedure for constructing these tables is as follows:

- Step 1. The first constraint point in the Medical Physicians departmental table is that point associated with 1.5 physicians. Since an Internist is required for every 300 clinic visits. The form of the staffing guide equation to use is:

$$X = \frac{Y - 1 + .00333\ (300)}{.00333}$$

which simplifies to:

$$X = \frac{Y}{.00333}$$

Substituting 1.5 for Y in the above equation, X equals 450. This is the first constraint point (i.e. the point at which a second internist would be required).

- Step 2. The second constraint point is merely 450 + 300 = 750. Continue building this table in increments of 300.

- Step 3. Build departmental tables for the other physician classes using the following factors:
  - Surgical Physicians - X = Y/.00222 (increments of 450)
  - OB/GYN Physicians - X = Y/.0025 (increments of 400)
  - Other Physicians - X = Y/.008 (increments of 125)

3.2.12 Radiology

The construction of this table merely requires the expansion of the staffing guide table, as contained in the General Technical Approach, for the Department of Radiology.

3.2.13 Pathology

The workload measure in the staffing guide table for the Department of Pathology is not equivalent to the product outputs used in this methodology. The staffing guide measure, rather than being weighted by the complexity of various laboratory tests is the unweighted number of tests performed. In order to convert the staffing guide table into a departmental table, some measure of the number of unit values (CAP system) per test is required.

The construction of the Pathology departmental table proceeds, therefore, as follows:

- Step 1. Expand the staffing guide table according to the techniques in the General Technical Approach.
- Step 2. Obtain from the department of Pathology, a workload breakdown for each quarter of the base year. This workload should be subdivided into the various sections of the laboratory (e.g., microbiology, hematology, chemistry, blood bank, etc.), and into unweighted tests and unit values as follows:

Section (i)	Tests (X)	Unit Values (Y)
1	X_{1j}	Y_{1j}
2	X_{2j}	Y_{2j}
3	X_{3j}	Y_{2j}

where: X_{ij} = tests performed in section i during quarter j

Y_{ij} = unit values of tests performed in section i during quarter j

- Step 3. Determine the weighted average ratio of unit values/test (See Exhibit III-23). This is accomplished by:

  - Dividing the unit values by tests for each section for each quarter of the base year.

    $(Z_{ij} = Y_{11}/X_{11};\ Y_{12}/X_{12};\ \ldots\ Y_{21}/X_{21};\ Y_{22}/X_{22};\ \ldots\ Y_{n4}/X_{n4})$

  - Summing the unit values across all sections and quarters

$$\sum_{i=1}^{n}\ \sum_{j=1}^{4} Y_{ij} = Y_{11} + Y_{12} + Y_{13} + \ldots + Y_{21} + \ldots + Y_{n4}$$

  - Dividing the unit values for each section for each quarter by the above sum to determine the percentage distribution of unit values among sections and quarters

    $(S_{ij} = Y_{11}/\Sigma\Sigma\ Y_i;\ Y_{12}/\Sigma\Sigma\ Y_{ij};\ \ldots\ Y_{n4}/\Sigma\Sigma\ Y_{n4})$

  - Multiplying each ratio (unit values/test), obtained first, by its corresponding percentage.

    $(W_{ij} = Z_{11} \bullet S_{11}\ ;\ Z_{12} \bullet S_{12};\ \ldots\ Z_{21} \bullet S_{21}\ \ldots\ Z_{n4} \bullet S_{n4})$

  - Summing the products obtained above. The result is the weighted average ratio of unit values per test

$$\sum_{i=1}^{n}\ \sum_{j=1}^{4} W_{ij} = \sum_{i=1}^{n}\ \sum_{j=1}^{4} Z_{ij} \bullet S_{ij}$$

Exhibit III-23

Worksheet to Calculate the Weighted Average Ratio of CAP Weighted Unit Values/Test

(A) Section (I)	(B) Quarter (J)	(C) Tests	(D) Unit Values	(E) Values/Test (D ÷ C)	(F) Percentage Values ($D \div \Sigma\Sigma Y_{ij}$)	(G) Weighted Values (F X E)
1	1	X_{11}	Y_{11}	Z_{11}	S_{11}	W_{11}
	2	X_{12}	Y_{12}	Z_{12}	S_{12}	W_{12}
	3	X_{13}	Y_{13}	Z_{13}	S_{13}	W_{13}
	4	X_{14}	Y_{14}	Z_{14}	S_{14}	W_{14}
Subtotal		ΣX_1	ΣY_1	ΣZ_1	ΣS_1	ΣW_1
2	1	X_{21}	Y_{21}	Z_{21}	S_{21}	W_{21}
	2	X_{22}	Y_{22}	Z_{22}	S_{22}	W_{22}
	3	X_{23}	Y_{23}	Z_{23}	S_{23}	W_{23}
	4	X_{24}	Y_{24}	Z_{24}	S_{24}	W_{24}
Subtotal		ΣX_2	ΣY_2	ΣZ_2	ΣS_2	ΣW_2
3	1	X_{31}	Y_{31}	Z_{31}	S_{31}	W_{31}
	2	X_{32}	Y_{32}	Z_{32}	S_{33}	W_{32}
	3	X_{33}	Y_{33}	Z_{33}	S_{32}	W_{33}
	4	X_{34}	Y_{34}	Z_{34}	S_{34}	W_{34}
Subtotal		ΣX_3	ΣY_3	ΣZ_3	ΣS_3	ΣW_3
•	•	•	•	•	•	•
•	•	•	•	•	•	•
•	•	•	•	•	•	•
n	1	X_{n1}	Y_{n1}	Z_{n1}	S_{n1}	W_{n1}
	2	X_{n2}	Y_{n2}	Z_{n2}	S_{n2}	W_{n2}
	3	X_{n3}	Y_{n3}	Z_{n3}	S_{n3}	W_{n3}
	4	X_{n4}	Y_{n4}	Z_{n4}	S_{n4}	W_{n4}
Subtotal		ΣX_n	ΣY_n	ΣZ_n	ΣS_n	ΣW_n
Totals		$\Sigma\Sigma X_{ij}$	$\Sigma\Sigma Y_{ij}$	$\Sigma\Sigma Z_{ij}$	$\Sigma\Sigma S_{ij}$	$\Sigma\Sigma W_n = \Sigma\Sigma Z_{ij} \cdot S_{ij}$

- Step 4. Multiply the ratio obtained in Step 3 by each product output level obtained in Step 1.

3.2.14 Pharmacy

The workload measure in the staffing guide table for Pharmacy is not comparable to the product output of the department of Pharmacy used in this methodology. However, through interviews with pharmacy personnel, some relationship between the Medical Care Composite Unit (MCCU) and prescriptions was determined. It was agreed that twelve personnel resources were sufficient to meet the average monthly workload (in prescriptions, all other workloads weighted to prescriptions) experienced during the base period.

This workload (273,594 prescription equivalents) was considered the midpoint for twelve resources. That is, these same twelve would not need to be augmented by a thirteenth personnel resource until the workload increased to the point at which twelve and one half resources are required. This workload, however, includes 1,247 sterile products delivered monthly. Since personnel required to prepare sterile products are computed from a different staffing guide table, the sterile product workload must be subtracted from the total average monthly product outputs of the department of Pharmacy in order to relate these products to MCCU.

This net workload (19059/month) then is associated with 11 resources (the resources associated with sterile products have also been removed from the analysis). The ratio of this workload to the MCCU associated with exactly 11 resources in the staffing guide table is then used to convert MCCU to the product outputs of the department of Pharmacy used in this methology.

To construct the table for the department of Pharmacy, perform the following steps:

- Step 1. Expand the staffing guide table for Pharmacy in accordance with the General Technical Approach.
- Step 2. Determine the MCCU's associated with exactly 11 personnel resouces (i.e., substitute 11 for Y in the equation in the General Technical Approach)
- Step 3. Divide 19059 by the number obtained in Step 2.

- Step 4. Multiply each product output level determined in Step 1 by the number obtained in Step 3. The results are product outputs in terms of prescriptions.

- Step 5. Another table is also needed to account for product constraint points in the Sterile Products subsection of the department of Pharmacy. First expand the staffing guide table for Sterile Products in accordance with the General Technical Approach.

- Step 6. Multiply each product output level identified in Step 5 by 30 to convert these levels into monthly, as opposed to daily, products.

- Step 7. Multiply the product output levels obtained in Step 6 by 3 to convert these workload measures to prescription equivalents.

- Step 8. From the Pharmacy determine the total pharmacy output produced during the base year. Also determine the total sterile products delivered during the base year in prescription equivalents. Divide total output by sterile product output.

- Step 9. Multiply the ratio obtained in Step 8 times each product output level obtained in Step 7. The result is a departmental table for Sterile Products in terms of the product output (prescriptions) of the department of Pharmacy.

3.2.15 Food Service

Eight tables must be constructed to account for the resources in this department. The steps to follow to construct these tables are:

- Step 1. Expand the staffing guide table for each of the following sections as in the General Technical Approach:
  - Clinical Detetics
  - Food Production and Service
  - Pastry
  - Cooks
  - Meat Processing
  - Food Service Attendants
  - Tray Service Attendants
- Step 2. Since the staffing guide measure used for the sections in Step 1 is rations, these must be converted to meals. This is accomplished by merely multiplying each product output level in each section determined in Step 1 by 3 (i.e. 3 meals per ration)
- Step 3. Expand the staffing guide table for Office of the Chief, Food Service as in the General Technical Approach.

3.2.16 Ambulance Service

Since the staffing guide table for this department does not specify any workload measure, it cannot be used to develop a departmental table. But data at the facility may be helpful. To construct this table consider the following steps:

- Step 1. Randomly choose two months of trip reports or other records of time per ambulance run. A record of each run is usually maintained to include time out and time in.
- Step 2. For each run in each month, calculate the amount of time spent (time in minus time out) in minutes.
- Step 3. Sum the numbers determined in Step 2 and divide by the total number of runs sampled. The result is an estimate of the average time (in minutes) per ambulance run
- Step 4. Divide 9081 (calculated by dividing the time in minutes available per person per month for work assuming a 40 hour work week -- 10080 -- by the leave factor 1.11) by the number obtained in Step 3. The result is the number of runs that one person can perform during one month.
- Step 5. The base level of resources equals 10 persons, 5 ambulance drivers and 5 emergency medical technicians. This base level allows for full time, seven day per week coverage for emergencies.
- Step 6. Since each run requires two people, divide the number obtained in Step 4 by 2. The result is the interval rate in runs between constraint points.
- Step 7. The first constraint above the zero product output level is the number obtained in Step 6 divided by 2.

- Step 8. To determine the next constraint point, add the interval rate obtained in Step 5 to the constraint obtained in Step 7. The table then continues in increments of this same interval. The resources necessary at each point are alternating ambulance drivers and emergency medical technicians.

3.2.17 Linen

The staffing guide yardstick measure is the MCCU. Since, like in Pharmacy, this measure is not comparable to the product output measure of the department of Linen, the two must be reconciled. The technique used to construct the departmental table is as follows:

- Step 1. Expand the staffing guide table for Linen as in the General Technical Approach.
- Step 2. Take the ratio of the average monthly pieces of linen delivered during the base year (from line 220 of the Supplemental Med-302 Report) to average monthly MCCU experienced during the base year.
- Step 3. Multiply each workload level determined in Step 1 by the ratio obtained in Step 2.

3.2.18 Medical Maintenance

This table is constructed by merely expanding the staffing guide table for Medical Maintenance as in the General Technical Approach.

3.2.19 Medical Material

In constructing the departmental table for Medical Material, the procedures outlined in the General Technical Approach are followed with one modification, the staffing guide tables must be converted to requisitions. The staffing guide tables applicable to this department are:

- Inventory Management
- Storage and Distribution
- Delivery and Pickup
- Property Control

The following steps are required to develop a departmental table for the department of Medical Material:

- Step 1. Expand the staffing guide tables for the above sections as in the General Technical Approach.
- Step 2. The staffing guide workload measures for Inventory Management, Storage and Distribution and Property Control are "line items". The number of line items processed by each section during any month may be found on lines 221, 222, and 224 respectively of the Supplemental Med-302 Report. In order to construct departmental tables for each section in terms of requisitions it is necessary to convert the measures line items to requisitions. Obtain the total number of requisitions and the total number of line items in each section for the base year from the Chief, Supply and Services Division. Divide the total line items experienced by the section, Inventory Management over the base year into the total requisitions in the same period. The result is the number of requisitions per line item in Inventory Management. Repeat this step for the sections; Storage and Distribution and Property Control.
- Step 3. Convert the staffing guide table for Inventory Management from line items to requisitions by multiplying each constraint point in the table derived in Step 1 by the factor obtained in Step 2. Repeat this step for the other two tables.

- Step 4. Convert items delivered and picked up to requisitions. Obtain the number of items delivered over the base year from the Supplemental Med-302 Report (line 223) (for example, 36,000 deliveries). Divide this number by the number of requisitions experienced over the same period (e.g., 12,000 - 1.5). This is the number of deliveries and pickups per requisitions.

- Step 5. Using the factor derived in Step 4, convert the Delivery and Pick-up table to requisitions as in Step 3.

3.2.20 Administration

As stated previously, the department of Administration consists of the following sections:

- Management Services Division
- Office of the Chief, Supply and Services Division
- Admissions and Dispositions
- Clinical Records and Reports
- Medical Transcribing
- Outpatient Records
- Hospital Treasurer
- Chief, Patient Administration Division
- Chaplain Division
- Central Material Service
- Reproduction
- Mail Room
- Adjutant
- Plans Operations and Training Division
- Medical Company

To construct the departmental tables for each of these administrative sections:

- Step 1. Expand the staffing guide tables associated with each section according to the General Technical Approach.

- Step 2. Since the staffing guide workload measure for the Management Services Division is the Health Care Composite Unit (HCCU), the departmental table for this division must be adjusted to reflect the specified product output (MCCU). Therefore determine from the facility the average monthly HCCU and the average monthly MCCU experienced during the base year.

- Step 3. Subtract the average monthly MCCU from the average monthly HCCU. The result is the HCCU measures associated with dental patients who are not considered in this methodology.

- Step 4. Subtract the number obtained in Step 3 from each product output constraint level in the expanded staffing guide table for Management Services division. The result is a departmental table for this administrative section in terms of the MCCU.

3.2.21 Composite Staff

In order to complete the departmental tables, one last step must be accomplished. A composite staff profile of each departmental table must be constructed. Steps 1 to 5 pertain to departmental tables without physicians and steps 6 to 8 pertain to departmental tables that include physicians.

- Step 1. Take the military cost of each resource in the Medical Hospitalization departmental table and sum. The costs may be derived from cross referencing the resource type and grade at each constraint point with the Military Personnel Resource Cost Table.

- Step 2. Divide the summed costs obtained in Step 1 by the total resources identified in the table.

- Step 3. Reference the average cost obtained in Step 2 to the Military Personnel Resource Cost Table. The military personnel cost nearest to the average is determined.

- Step 4. The resource type and grade associated with the cost obtained in Step 3 is the composite personnel resource for the department of Medical Hospitalization.

- Step 5. Repeat Steps 1 through 4 for all other departments which do not have physician resources.

- Step 6. Repeat Steps 1 through 4 for physician resources only, in departmental tables with this resource type.

- Step 7. Repeat Steps 1 through 4 for non-physicians in departments with physician resources.

- Step 8. In departments with physician resources two composites were calculated. One for non-physicians, obtained in Step 7; and one for physicians, obtained in Step 6.

3.3 CONSTRUCTING THE RESOURCE COST TABLES

These tables illustrate the costs associated with each resource which may need to be acquired as constraints in any one or more of the departments are breached due to increased levels of patients served. There are five specified resources. These are:

- Three personnel resources:
  - Officers with medical specialties
  - Other officers
  - Enlisted Personnel
- Equipment
- Materiel

The first three are treated alike and are contained in two Personnel Resource Cost Tables (one for military and one for civilian personnel). The last two are treated separately in an Equipment Resource Cost Table and a Materiel Resource Cost Table.

3.3.1 Personnel Resource Cost Table

This table contains the monthly cost of each of the three resource categories by pay grade. Exhibit III-24 illustrates this table. This two dimensional matrix relates the resource types along the top to pay grades along the left. The cells of the matrix contain the average monthly cost of particular resources at particular grades (FY 1977 in the exhibit). Obviously some of the cells will be empty. For example, Officers with Medical Speciality will not be correlated with any pay grade less than 0-1. Similarly, a Radiology Technician would not be correlated with any pay grade above E-9.

This table is predicated upon the resources being military as opposed to civilian. This obtains for two reasons:

- The staffing guide, used to develop the departmental products, uses precise military grades but not civilian.
- For each military position title, there is identified a comparable civilian position title.

In order to fully delineate the costs of resources which may be required but not yet acquired, a precise grading structure is necessary. But this does not preclude substituting civilian for military positions.

The substitution of a civilian for the acquisition of a military personnel resource may be treated in one of three ways. First, a separate resource table may be developed for civilian personnel resources such that once the resource to be purchased and its status (vis a vis military or civilian) is determined, the decision-maker is directed to a military or civilian resource cost table.

A second way of treating the costs of civilian versus military personnel is to equate the costs of civilian personnel to the costs of military personnel directly in one table. That is, build the table around military personnel categories but include a method (e.g., ratio or other mathematical factor) which equates a particular military person with a civilian counterpart.

A third method is to predicate all tables on military personnel and to consider the alternative costs of civilian personnel only at the decision point. That is, consider the

Exhibit III-24

Military Personnel Resource Cost Table

(FY 1977)

Grade \ Resource Type	Officers With Medical Specialties (R-1)	Other Officers (R-2)	Enlisted (R-3)
06	5270	4080	-
05	4557	3361	-
04	4002	2790	-
03	3468	2278	-
02	2925	1735	-
01	2419	1229	-
W4	-	2611	-
W3	-	2198	-
W2	-	1781	-
W1	-	1456	-
E9	-	-	2059
E8	-	-	1734
E7	-	-	1481
E6	-	-	1223
E5	-	-	965
E4	-	-	789
E3	-	-	675

costs of civilian versus military personnel only after it has been determined that a resource, of a certain type and grade, must be acquired to meet the demands of increased patient care. This last method obviates the need to construct a second table or to determine the statistical relationship between military and civilian personnel costs based on historical (and, hence, less than optimum) data.

The first alternative is the one used in this methodology. There are two personnel resource costs tables which reflect the military and civilian costs of personnel resources separately.

The following steps are required to construct the Personnel Resource Cost Table:

- Step 1. Within each cell of the table, place the appropriate cost, using the grade structure, obtained from the "Standard Rates for Costing Military Personnel Services" (DOD Instruction 7220.25).

- Step 2. Adjust the pay rates obtained in Step 1 for expected retirement costs. This adjustment is the product of the retirement accrual rate (17%) times the standard wage, by grade, times the percentage of personnel in each grade expected to retire (see Schedule 2 of Memorandum OASD (Comptroller), Subject: Economic Cost of Military and Civilian Personnel, dated March 22, 1974). Add these costs to the rates obtained in Step 1.

- Step 3. Adjust the pay rates obtained in Step 2 to account for "wage acceleration." To account for this value of quarters, subsistence, commissary and exchange benefits, multiply officer pay grades by 1.08 and enlisted pay grades by 1.23.

- Step 4. Physicians are authorized one or more allowances over and above pay and allowances authorized all other officers. These allowances are special pay, continuation pay and variable incentive pay. Physician costs must be adjusted to account for these allowances. Therefore, obtain:

  - Current tables 1-5-2, 1-5-3, and 1-5-4 of the DoD Pay Manual

- Number of physicians by grade receiving Continuation Pay during the base year
- Total number of physicians by grade in the Medical Corps during the base year
- Total dollars paid out in Continuation Pay during the base year
- Number of physicians receiving Variable Incentive Pay (VIP) by years of service (4-13, 14-19, 20-25, over 26, and obligated as per Table 1-5-3, DODPM)
- Number of physicians receiving specialty pay during the base year
- Total dollars paid out in speciality pay during the base year.

• Step 5. To compute the average Variable Incentive Pay per physician (see Exhibit III-25):

- Place in column (B) the number of physicians receiving VIP by years of service
- Calculate the percentage distribution of column (B) by dividing each number by the sum of column (B)
- Calculate the average VIP per years of service category by summing across each row in Table 1-5-3 of the DODPM and dividing by 4. For example, if a physician has between 4 and thirteen years of service, he may receive a VIP of $12,000 for a one year active duty commitment, $12,500 for 2 years, $13,000 for 3 years, or $13,500 for 4 years. The average of these four columns is $12,750 ($51,000/4). Place these averages in column (D) of Exhibit III-25
- Multiply the percentages in column (C) times the average payment in column (D) to compute column (E) of Exhibit III-25

Exhibit III-25

Computation of Average VIP per Physician

(A) Years of Service	(B) Number of Physicians	(C) %	(D) Average Payment	(E) Weight
4-13	679	39.1	$12,750	$ 4,985
14-19	237	13.7	12,250	1,678
20-25	189	10.9	11,475	1,251
over 26	76	4.4	10,475	461
Obligated	554	31.9	9,000	2,871
TOTAL	1735	100.0		$11,246

Average monthly VIP = $11,248/12 = $937

- The sum of column (E) divided by 12 is the average VIP payment per physician per month ($937) regardless of pay grade.

- Step 6. To compute the average specialty pay per physician, divide the total dollars paid out in specialty pay during the base year by the total number of physicians receiving this pay. This result divided by twelve is the average specialty pay allowance per physician per month regardless of pay grade.

- Step 7. To compute the average continuation pay per physician per month:

  - Divide the total dollars paid out in continuation pay by the total number of physicians receiving this pay to compute the average continuation pay per physician

  - Divide the total number of physicians in grade 06 (Colonel) receiving continuation pay by the total number of Medical Corps colonels and multiply this percentage times the average pay obtained above. The result divided by twelve is the average continuation pay per month for a colonel

  - Repeat the above substep for physicians in pay grades 05 and 04.

- Step 8. Add the costs obtained in Steps 5, 6 and 7 to the costs obtained in Step 3.

The civilian personnel resource cost table is identical in format to Exhibit III-24. However, the cells of the matrix will reflect civilian costs rather than military costs. This fact requires that civilian pay grades be equated to military pay grades. Since this is difficult in practice an approximate equation was determined from two sources:

- Table 4-1 of AR 210-16 (29 July 1975)

- The Third Quadrenial Review of Military Compensation, December, 1976

The results are contained in Exhibit III-26. To construct the Civilian Personnel Resource Cost Table:

- Step 9. Obtain a Federal Pay Schedule.

- Step 10. For each pay grade, take the annual salary at the step 5 level and divide by 12. The result is the monthly salary cost of civilians by grade.

- Step 11. Multiply each salary cost obtained in Step 10 by the following rates:

  - Retirement (currently 7.14%)

  - Health Benefit (currently 1.0%)

  - Life Insurance Benefit (currently .3%)

  Add these figures to the costs obtained in Step 10. The result is the civilian costs by grade adjusted to reflect retirement, health and life insurance benefits.

- Step 12. The civilian costs of Officers with Medical Specialties is considered to be a constant. Therefore, in each cell of the table corresponding to this personnel resource type, place the adjusted cost of a civilian, pay grade GS-14.

- Step 13. The civilian cost of an Other Officer, grade 01 equals the average cost of a GS-9 added to the average cost of a GS-7 and the sum divided by two.

- Step 14. The civilian costs of all other personnel types and grade are the costs obtained in Step 11 of equivalent military pay grades from Exhibit III-26.

Exhibit III-26

Approximate Equivalent Military and Civilian Pay Grades

Military	Civilian (GS)	Wage Grade
O6	GS-15	
O5	GS-14	
O4	GS-12	
O3	GS-11	
O2	GS-9	
O1	GS-9/GS-7	
W4	GS-9	
W3	GS-9	
W2	GS-7	
W1	GS-7	
E9	GS-9	
E8	GS-8	WS-10
E7	GS-7	WS10/WS9
E6	GS-6	WS9
E5	GS-5	WS10
E4	GS-4	WG8
E3	GS-3	WG6

3.3.2 Equipment Resource Cost Table

This table is constructed simply by listing all potential equipment acquisitions and the cost of purchasing that equipment. The potential equipment acquisitions can be obtained from the departmental tables which identify equipment constraints on product output.

This purchase cost must be adjusted, however, to account for depreciation and the time horizon of the decision model. The total purchase cost, then must be divided by the useful life of the equipment or eight years, whichever is less (straight line depreciation) and again by 12 (monthly cost). If the purchase cost of a piece of equipment is less than $1,000, do not depreciate but do divide by 12 to obtain the monthly cost.

It should also be remembered that the acquisition of a physician may entail, as well, the purchase of a standard instrument package (e.g., stethescope, etc.). Similarly a clerk may also require a desk, chair, filing cabinet, etc. These must be taken into account in the Equipment Resource Cost Table as each personnel resource is acquired.

3.3.3 Materiel Resource Cost Table

Since materiel costs are considered purely variable, this table takes the form of the classification matrix (see Exhibit II-1) with the materials cost per patient type filling the cells. These costs may be determined in one of two ways. First, the simplest method, is to take the coefficients of the department of Medical Materiel applicable to each patient type and multiply by the average cost per requisition. This method is derived from the manner in which those coefficients were themselves constructed.

Another method is to follow the steps in constructing the coefficients for Medical Materiel eliminating the step of dividing total dollar cost of materiel by total requisitions.

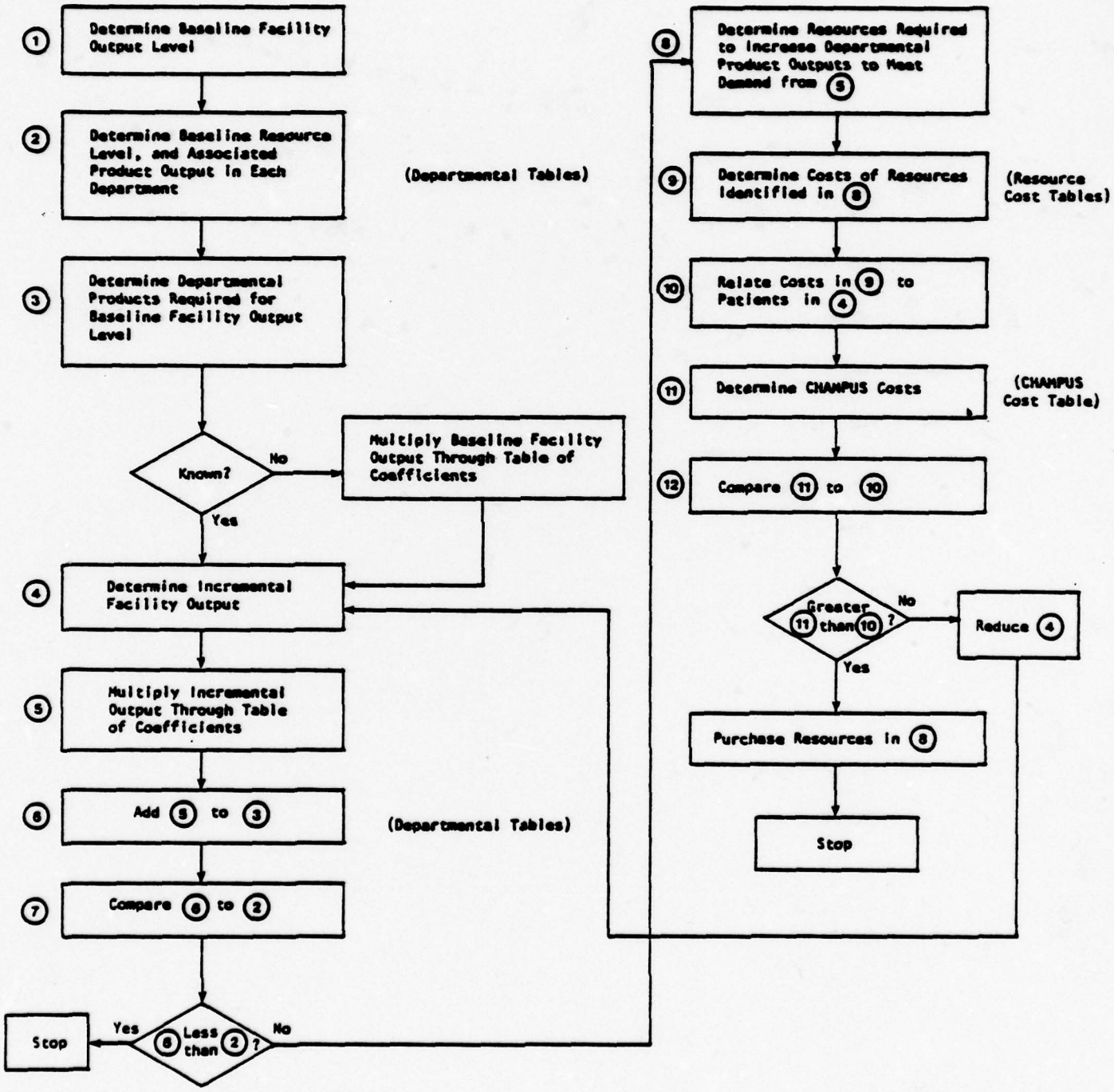
IV. DETERMINING THE MARGINAL COST OF HEALTH SERVICES

This chapter details the procedures to follow in order to use the information developed in Chapter III to determine the marginal cost of serving patients in a military medical treatment facility. Based on the definition of marginal cost in Chapter II, this means determining the cost associated with increasing patients served by determining the costs of additional resources required to serve those incremental patients. This process, requires the following steps which are detailed in the remainder of this chapter and illustrated in Exhibit IV-1:

- Determine the Baseline Resource and Facility Output Levels
- Determine the Departmental Product Constraints Associated with the Baseline Resource Level
- Determine Total Facility Output (Baseline plus Incremental)
- Determine Departmental Product Output Associated with Total Facility Output
- Determine Resources Required to Produce Departmental Products Associated with Facility Output
- Compare the Above with the Baseline Resource Level
- Identify Resources Which Must be Acquired to Meet Total Facility Output
- Determine Costs of Purchased Resources
- Relate Resource Costs to Incremental Facility Output.

Exhibit IV-1

Flowchart to Determine the Marginal Cost of Health Services In a Military Medical Treatment Facility



In order to complete the decision framework, however, one more step is required:

- Compare cost with CHAMPUS.

The purpose of this chapter is to describe each of these 10 steps in detail using data for selected departments and the work sheets contained in Exhibits IV-2, Marginal Cost Estimates, and IV-3, Consolidated Departmental Table. Exhibit IV-2, the Marginal Cost Table, is used to display the baseline and incremental facility outputs, the marginal costs, and CHAMPUS costs. Exhibit IV-3, the Departmental Consolidation Table, displays the various levels of personnel resources and departmental product outputs associated with baseline resources, baseline output and total output. Both of these exhibits are referenced throughout this chapter and different columns of both are completed during each of the 10 major analytical steps.

Exhibit IV-2

Marginal Cost Estimates

Beneficiary (A)	Service (B)	Service Measure (C)	Baseline Facility Output (D)	Incremental Output (E)	Case I (F)
Active Duty	Medical	Patient Stay			
		Ambulatory Clinic Visit			
	Surgical	Patient Stay			
		Ambulatory Clinic Visit			
	Obstetrics	Delivery			
	Gynecology	Patient Stay			
		Ambulatory Clinic Visit			
	Other	Patient Stay			
		Ambulatory Clinic Visit			
Dependents of Active Duty	Medical	Patient Stay			
		Ambulatory Clinic Visit			
	Surgical	Patient Stay			
		Ambulatory Clinic Visit			
	Obstetrics	Delivery			
	Gynecology	Patient Stay			
		Ambulatory Clinic Visit			
	Pediatrics	Patient Stay			
		Ambulatory Clinic Visit			
	Other	Patient Stay			
		Ambulatory Clinic Visit			
Retired	Medical	Patient Stay			
		Ambulatory Clinic Visit			
	Surgical	Patient Stay			
		Ambulatory Clinic Visit			
	Gynecology	Patient Stay			
		Ambulatory Clinic Visit			
	Other	Patient Stay			
		Ambulatory Clinic Visit			
Dependents of Retired and Survivors	Medical	Patient Stay			
		Ambulatory Clinic Visit			
	Surgical	Patient Stay			
		Ambulatory Clinic Visit			
	Obstetrics	Delivery			
	Gynecology	Patient Stay			
		Ambulatory Clinic Visit			
	Pediatrics	Patient Stay			
		Ambulatory Clinic Visit			
	Other	Patient Stay			
		Ambulatory Clinic Visit			

Marginal Costs			CHAMPUS Costs		
	Case II (G)	Case III (H)	Government (I)	Patient (J)	Total (K)

Exhibit IV-3

Departmental Consolidation Table

LINE	Department	ACTUAL			STANDARD		Output Req'd to Serve Basic Plus Additional Patients	Staff Required to Serve Total Demand (G)	MARGINAL STAFF		MARGINAL STAFF COSTS	
		Staff	Constraint (Based on Actual Staff-B)	Output (Products Actually Produced)	Staff (Needed to Produce Actual Products-D)	Constraint (Based on Standard Staff-E)			Between Actual & Required (H - B)	Between Standard & Required (H -E)	Between Actual & Required (Costs of I)	Between Standard & Required (Costs of J)
	A	B	C	D	E	F	G	H	I	J	K	L

C-A7

4.1 DETERMINE BASELINE RESOURCE AND FACILITY OUTPUT LEVELS

This initial step is concerned with specifying the baseline output level of patients served, the departmental products required to serve those patients and the resources required to produce these departmental products. Per the marginal cost definition, these are the points beyond which the costs of additional resources are relevant to the decision model. There are three concepts to consider in this step:

- The baseline facility output
- The baseline resources
- The baseline departmental products.

The baseline facility output is determined by the decision model desired. That is, it is specified as either the active duty patients served or the actual patients served. These patients classified by patient type will be recorded in column (D) of Exhibit IV-2.

Two techniques may be used to determine the baseline resource level. The first is to merely specify the resources, including borrowed labor, for each hospital department. This technique is usually appropriate to the decision models corresponding to:

- The marginal costs of increasing patients served above present levels
- The marginal costs of increasing patients served above those that can be served by contingency levels of resources.

The baseline resources required to serve active duty patients only are determined using the second technique. This is as follows:

- Step 1. Multiply the baseline facility output (active duty patients classified into service and service measure categories) through the Table of Coefficients. That is, if there are 100 active duty, medical patient stay patients, each of whom would be expected to use 5.7 (the coefficient) bed days of Medical Hospitalization, multiply 100 by 5.7. The result (570) is the total

product outputs of the department of Medical Hospitalization required by active duty patient stay patient types. Repeat this procedure for the other patient types utilizing this department.

- Step 2. Sum the products obtained in Step 1. The result is the total departmental products of Medical Hospitalization required for the baseline facility output.

- Step 3. Take the number obtained in Step 2 and reference the departmental table for Medical Hospitalization. Place this number in sequence on the table (i.e., 570 bed days comes between 562.5 and 637.5 in Exhibit IV-4).

- Step 4. Determine the number of resources required to produce this facility output based strictly on workload. These are the resources associated with every constraint point below the product output determined in Step 2 (e.g., 17).

- Step 5. Adjust this staffing level for local appraisal (see section 4.2 for a discussion of the effects of local appraisal on constraint points and for a technique to construct local appraisal factors). This is accomplished by dividing the number obtained in Step 4 by the local appraisal factor (assuming a local appraisal factor of .83, 17 / .83 = 20.48) and rounding to the nearest whole number (e.g., 20). The result is the baseline personnel resource level which appears in column (B) (i.e., Actual) of Exhibit IV-3.

- Step 6. Repeat steps 1 through 5 for all the other departments for which there is a departmental table considering the following refinements:

  - Remember that for clinics departments composed of multiple clinics, the summed column will be that corresponding to each individual component clinic. There may be ten coefficients associated with Surgical Clinics, for example, to account for ten component clinics. Each component clinic column, then, must be summed.

Exhibit IV-4

Departmental Table for the Department of
Medical Hospitalization

Product Output (Bed Days)	Resource Constraint		
	Type	Code	Grade
0	Base = 5 Nurses	R-2	03/02
	1 Chief Wardmaster	R-3	E-7
	1 Ward Attendant	R-3	E-3
	1 Ward Specialist	R-3	E-4
	1 Clinical Specialist	R-3	E-5
37.50	Ward Attendant	R-3	E-3
112.5	Ward Specialist	R-3	E-4
187.5	Reports Clerk	R-3	E-4
262.5	Clinical Specialist	R-3	E-5
337.5	Senior Ward Specialist	R-3	E-5
412.5	Senior Clinical Specialist	R-3	E-6
487.5	Ward Attendant	R-3	E-3
562.5	Senior Clinical Specialist	R-3	E-6
637.5	Ward Attendant	R-3	E-3
712.5	Ward Specialist	R-3	E-3
787.5	Clinical Staff Nurse	R-2	02
862.5	Senior Ward Specialist	R-3	E-5
	Clinical Head Nurse (Upgrade)	R-2	02/03/04
950.1	Reports Clerk	R-3	E-4
1050	Clinical Staff Nurse	R-2	02
1149.9	Clinical Specialist	R-3	E-5
1275	Ward Attendant	R-3	E-3

Exhibit IV-4 — Cont.

Product Output (Bed Days)	Resource Constraint		
	Type	Code	Grade
1425	Clinical Staff Nurse	R-2	02
	COMPOSITE = R-3, E-5		

- The demands for the department of Medical Physicians will be the sum of the products of the demands for:

  .. Medical Hospitalization bed days times .25

  .. Internal Medicine Clinic visits times 1.0

  .. Allergy Clinic visits times 1.333.

  These factors (.25, 1.0 and 1.33) equate the workload measures of these departments to the product output measure of the department of Medical Physicians.

- The demands for the department of Surgical Physicians equals the sum of the products of the demand for:

  .. Surgical Clinic Visits times 1.0

  .. Surgical Hospitalization I bed days (exclusive of demands for this department's products placed by gynecology patient types) times .5

  .. Podiatry Clinic visits times 1.125

  .. Urology Clinic visits times 1.5

  .. Ophthalmology Clinic vists times .75

  .. Orthopedic Clinic visits times 1.261.

- The demands for the department of OB/GYN Physicians will equal the sum of the products of the demands for:

  .. OB/GYN Clinic visits associated with gynecology patient types times 1.0

  .. OB/GYN Clinic visits associated with obstetric patient types times .782

  .. OB/GYN Hospitalization bed days associated with obstetrics patient types times .444

.. Surgical Hospitalization I bed days associated with gynecology patient types times .444 .

- The demands for the department of Food Service consist of the sum of:

  .. The demands placed by patients by following Steps 1 and 2

  .. The demands placed by non-patients which is the number of personnel assigned times the average number of meals per person. The former is calculated by summing column (B) of Exhibit IV-3 and the latter is calculated as in section 3.1.5.

The baseline product outputs of each department are derived by following Steps 1 and 2 above for all hospital departments using the baseline facility output of patients served. The results reported in column (C) of Exhibit IV-3, represent the departmental products required to serve the baseline output of patients.

4.2 DETERMINE DEPARTMENTAL PRODUCT CONSTRAINTS ASSOCIATED WITH THE BASELINE RESOURCE LEVEL

The resources extant in each department are constrained from producing more than some specified level of departmental output. These constraints are determined, with modifications, by merely counting down each departmental table the number of extant resources, then noting the constraint associated with that number. This procedure must account for two additional factors, however:

- Local Appraisal (by the manpower survey team)
- Borrowed Labor.

A manpower survey team, when determining staffing requirements for each hospital department considers two factors:

- Observed workload
- Specific departmental characteristics.

Using the staffing guide, the manpower survey team first determines the number of resources that are necessary to produce the observed workload. Then, it considers the specific characteristics of each department to determine whether that staffing level is adequate (or more than adequate) to fulfill the responsibilities of that department. Such characteristics include (but are not limited to):

- Physical layout and limitations
- Additional responsibilities over and above that represented by the workload measure
- Patient characteristics (which may be different from that assumed in the workload measure)
- Organizational structure (two departments may be combined for efficiency purposes).

In focusing on the characteristics, the manpower survey team evaluates whether the staffing requirements determined strictly on the basis of workload (from the staffing guide) are sufficient to perform the duties of the department, as represented by the

workload measures, given the above limitations and/or economies. The manpower survey team then recommends a staffing level greater than, equal to, or less than a level based strictly on the staffing guide.

The departmental tables used in this methodology were based on the staffing guide. And as such, they account only for workload. They do not account for the other factors considered by the manpower survey team. In any department of any hospital, however, the effective capacity of individual resources is affected by these specific characteristics. Therefore, to determine the constraints on resources, in terms of product output (workload), this methodology must provide a technique to relate the resources to effective constraint levels.

To do this, it is assumed that the unique characteristics of a department affect each resource equally. That is, if the manpower survey team determined that on the basis of the specific characteristics of department X, two more people are needed than the 10 determined on the basis of observed workload only, each of the twelve resources is affected *equally* by the factors which gave rise to the 20% addition. In the methodology, it is necessary to determine how much of each resource (12) is required to produce the observed workload and how much is required to account for the specific characteristics which limit (or aid) these resources in the performance of their duties. And in terms of departmental constraints, this methodology is only concerned with the former.

The technique to use, then, is to construct a table in four columns (see Exhibit IV-5). Column (A) lists the departments of the hospital. The numbers in column (B) are the personnel resources in each department recommended by the manpower survey team as required to produce the observed workload given any limitations and/or economies identified in each department. The numbers in column (3) are the staffing requirements in each department determined strictly on the application of the staffing guide equation. The differences between the numbers in columns (B) and (C), then, are considered to be the incremental staff required by the specific characteristics of each individual department. But since it is assumed these characteristics affect all personnel resources equally, column (D) is calculated. The numbers in column (D) are merely the results of dividing the

Exhibit IV-5

Example of a List of Factors to Equate Actual Departmental Staff with Adjusted Requirements

(A) Department/Section	(B) Manpower Survey Requirements	(C) Staffing Guide Requirements	(D) Factor (C ÷ B)
Medical Ward	20	16.6	.83
CCU	13	13	1.0
Male Surgical Ward	17.8	16.8	.9438
Female Surgical Ward	19.8	20.8	1.0505
Operating Room	19.8	20.8	1.0505
Anesthesia Nursing	7.1	7.1	1.0
Anesthesiologist	1	1	1.0
A/P Partum	11.6	10.6	.9138
Nursery	11.4	11.4	1.0
Labor and Delivery	10.5	7.5	.7143
Pediatrics Ward	14.8	13.8	.9324
AMIC	15	15	1.0
Allergy Clinic	5	4	.8
Dermatology Clinic (Staff)	1.8	2.8	1.5556
Internal Medicine Clinic	5.4	4.4	.8148
Surgery Clinic	7.3	7.3	1.0
Ophthalmology Clinic	3	3	1.0
Optometry Clinic	9	9	1.0
Orthopedics Clinic	5	5	1.0
Cast Room	6	6	1.0
Brace Shop	2	2	1.0
Otolaryngology (ENT)	6	6	1.0
Podiatry Clinic	3.97	3.97	1.0
Physical Therapy Clinic	8	8	1.0
Urology Clinic	4	4	1.0
Emergency Room (not including MD's)	20.9	17.9	.8565
OB/GYN Clinics	6.78	5.78	.8525
Pediatrics Clinics-Physicians (one Nurse Clinician = one Physician)	7	5	.71429
Pediatrics Clinics-Ancillary	6	5	.8333
Social Work Service	8	9	1.125

numbers in column (C) by the numbers in column (B) (e.g., 16.6 / 20 = .83). These factors represent that portion of each individual resource in each department required to produce departmental output. The remainder of each resource (i.e., 1 minus the factor, example: 1 - .83 = .17) is that portion of each resource required by the specific characteristics of the department which limit or aid the resources in the performance of their duties.

These factors are used to determine the constraints on departmental resources in terms of product outputs (workload). Given a resource level in each department (whether it equals the manpower survey requirements, staffing guide requirements or some other number), one can determine the number of resources required strictly for the product outputs and the product output constraints on that number of resources.

Borrowed labor must also be taken into consideration. For the purposes of this methodology, borrowed labor is the resources allocated to the hospital from some other military unit (e.g., combat support hospital) for the purposes of job proficiency. Borrowed labor is considered relatively fixed and is merely a part of the baseline resource level, but over and above the resources allocated directly to the hospital. It may be considered as merely increasing the productive capacity of the departments to which borrowed labor is assigned.

To determine the departmental product constraints associated with the basic resource level, perform the following steps:

- Step 1. The number of resources extant in each department are known from section 4.1.

- Step 2. To determine the product output constraints on these resource levels, multiply the resources in the department of Medical Hospitalization (example, 20) by the local appraisal factor for this department (.83). Round the result to the nearest integer (17). This is the number of resources attributable solely to workload and not to other characteristics of the department.

- Step 3. Go to the Medical Hospitalization departmental table (Exhibit IV-4) and count down the table as many resources as was determined in Step 2 (example, 17).

- Step 4. Note the product output level associated with the resulting number of resources (example, 562.5).

- Step 5. The unconstrained productive capacity of these resources is the product output level just below the one identified in Step 4 (example, 637.5) This means that the resources finally identified can produce departmental products up to the next level where another resource must be acquired. Record this result in column (C) of Exhibit IV-3.

- Step 6. Repeat Steps 2 through 5 for all other hospital departments.

At this point columns (B) through (D) of Exhibit IV-3 are completed and appear as shown in Exhibit IV-6 which presents two possible cases:

- Where the constraint on resources (i.e., staff in column (B)) is greater than the products actually demanded by the baseline output of patients served (column (D)). That is, the resources extant in the departments of Medical Hospitalization, Surgical Hospitalization, Labor and Delivery, and Pediatrics Hospitalization are sufficient to meet the demands of the baseline output of patients for their services.

- Where the constraint on resources is less than the products actually demanded by the baseline output of patients served. That is, the resources extant in the departments of Radiology and Pathology are hypothetically insufficient to meet the demands of the baseline output of patients for their services.

In the latter case, the resources may be said to be "overproducing" relative to their capacity (i.e., capacity is defined as the constraint points). The reason for this occurrence is not known and could not be fully explored during this study. However, this methodology accounts for this "overproduction" by determining three marginal cost estimates for each decision model. Using the example at line 5 of Exhibit IV-6 (i.e., Radiology Department) some additional resource(s) are

Exhibit IV-6

Departmental Consolidation Table

LINE	Department	ACTUAL			STANDARD		Output Req'd to Serve Basic Plus Additional Patients	Staff Required to Serve Total Demand (G)	MARGINAL STAFF		MARGINAL STAFF COSTS	
		Staff	Constraint (Based on Actual Staff-B)	Output (Products Actually Produced)	Staff (Needed to Produce Actual Products-D)	Constraint (Based on Standard Staff-E)			Between Actual & Required (H - B)	Between Standard & Required (H -E)	Between Actual & Required (Costs of I)	Between Standard & Required (Costs of J)
	A	B	C	D	E	F	G	H	I	J	K	L
1	Medical Hosp.	18	487.5	450								
2	Surgical Hosp.	17	562.5	560								
3	Labor & Delivery	9	364	300								
4	Pediatrics Hosp.	14	288	105								
5	Radiology	23	17,547	20,000								
6	Pathology	25	312,850	330,000								
•	•											
•	•											
•	•											
•	•											
•	•											
40	•											

needed to meet the demands for films exposed placed by the baseline output of patients. In this methodology, an increase in patients, and therefore an increase in demands for films exposed, is being analyzed. Are the costs associated with rectifying the overproduction situation attributable to these incremental patients or not? The three marginal cost estimates do not answer that question. What they do illustrate, however, is the marginal costs of serving additional patients if:

- The total costs of increasing facility output include the costs of purchasing resources (3) required even to serve existing demand (20,000) if the existing resources (23) could not be expected to serve even one additional patient. This is a worst case situation.

- The costs of increasing facility output should only include the costs of purchasing additional units of capacity over the resources that would be justified on the basis of existing workload. In this case, the three resources that should have been purchased are a cost saving to the facility, or unnecessary, and the only relevant costs are those needed to purchase that resource(s) required strictly by the incremental output.

- In the case where expenditures for resources are justified and not made (as in the example) but would be made given a further increase in workload demands, part of these costs are relevant to the incremental patients served. In this case the relevant costs are those attributable to the resources required to increase product output from that demanded by the baseline output of patients (20,000) to that which is demanded by the incremental patients. In other words, only some portion of the costs of rectification are considered relevant.

These three cases are reported in columns (F), (G) and (H) respectively of Exhibit IV-2.

In this section of the methodology, then, it is necessary to determine the personnel resources necessary to produce the product outputs actually demanded by the baseline facility output of patients served and the product output constraints associated with those resources. This is desired so as to determine the number and costs of resources required for rectification. This is accomplished as follows:

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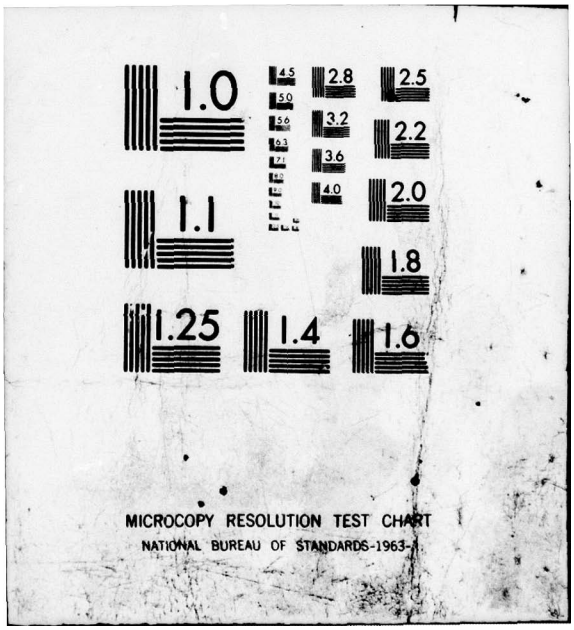
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
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- Step 7. Take the output in column (D), 450, associated with the department of Medical Hospitalization. Place this output in sequence in the Medical Hospitalization departmental table (between 412.5 and 487.5).

- Step 8. Determine the number of resources required to produce this facility output based strictly on workload. These are the resources associated with every constraint point below the product output determined in Step 7 (i.e., 15).

- Step 9. Adjust this staffing level for local appraisal. This is accomplished by dividing the number obtained in Step 8 by the local appraisal factor (assuming a local appraisal factor of .83, 15 / .83 = 18.07) and rounding to the nearest whole number (e.g. 18). The result is the staff needed to produce the actual products or standard staff. Record this in column (E) of Exhibit IV-3

- Step 10. Repeat steps 7 through 9 for all departments of the hospital. In the example on line 5 of Exhibit IV-6, the calculations are as follows (see Exhibit IV-7):

  - 20,000 films exposed is between constraints of 19,928 and 21,119

  - The number of resources associated with 19,928 products is 26

  - Assuming a local appraisal factor of 1.0, the staff needed to produce 20,000 actual products is 26 (26 / 1.0 = 26).

- Step 11. The constraint associated with the resources determined in Steps 9 and 10 are merely the constraints associated with the resources identified in Step 8. The results of Steps 7 through 11 for the examples are contained in Exhibit IV-8 which is an update of Exhibit IV-6 and IV-3.

Exhibit IV-7

Departmental Table for the Department of Radiology

Product Output (Films Exposed)	Resource Constraint		
	Type	Code	Grade
0	Base = Chief, Radiology	R-1	05104
	Chief X-Ray Specialist	R-3	E-6
2250	X-Ray Assistant	R-3	E-4
2750	Clerk	R-3	E-4
3250	X-Ray Specialist	R-3	E-5
3750	Senior Stenographer	R-3	E-5
4250	X-Ray Attendant	R-3	E-3
4750	Clerk	R-3	E-3
5250	Radiologist	R-1	03
5750	X-Ray Specialist	R-3	E-5
6312	X-Ray Attendant	R-3	E-3
6937	Clerk	R-3	E-3
7562	X-Ray Assistant	R-3	E-4
8187	X-Ray Specialist	R-3	E-5
8812	X-Ray Assistant	R-3	E-4
9437	X-Ray Specialist	R-3	E-5
10062	X-Ray Assistant	R-3	E-4
10687	X-Ray Specialist	R-3	E-5
	Chief X-Ray Specialist (Upgrade)	R-3	E-6 to E-7
11595	X-Ray Attendant	R-3	E-3
12785	X-Ray Assistant	R-3	E-4

Exhibit IV-7 — Cont.

Product Output (Films Exposed)	Resource Constraint		
	Type	Code	Grade
13976	Clerk Typist	R-3	E-3
15166	X-Ray Specialist	R-3	E-5
16357	Assistant Chief X-Ray Specialist	R-3	E-6
17547	X-Ray Attendant	R-3	E-3
18738	X-Ray Assistant	R-3	E-4
19928	X-Ray Specialist	R-3	E-5
21119	X-Ray Attendant	R-3	E-3
22309	X-Ray Assistant	R-3	E-4
23500	X-Ray Specialist	R-3	E-5
24690	X-Ray Attendant	R-3	E-3
25880	X-Ray Assistant	R-3	E-4
27071	X-Ray Specialist	R-3	E-5
28261	Radiologist	R-1	04
29452	X-Ray Assistant	R-3	E-4
30625	X-Ray Attendant	R-3	E-4
31875	X-Ray Assistant	R-3	E-4
33125	Senior Clerk	R-3	E-4
34375	X-Ray Specialist	R-3	E-5
35625	X-Ray Assistant	R-3	E-4
36875	X-Ray Specialist	R-3	E-5
38125	X-Ray Assistant	R-3	E-4
39375	X-Ray Specialist	R-3	E-5
	COMPOSITE = Physicians: R-1, 04		
	Staff: R-3, E-4		

Exhibit IV-8

Departmental Consolidation Table

LINE	Department	ACTUAL			STANDARD		Output Req'd to Serve Basic Plus Additional Patients	Staff Required to Serve Total Demand (G)	MARGINAL STAFF		MARGINAL STAFF COSTS	
		Staff	Constraint (Based on Actual Staff-B)	Output (Products Actually Produced)	Staff (Needed to Produce Actual Products-D)	Constraint (Based on Standard Staff-E)			Between Actual & Required (H - B)	Between Standard & Required (H -E)	Between Actual & Required (Costs of I)	Between Standard & Required (Costs of J)
	A	B	C	D	E	F	G	H	I	J	K	L
1	Medical Hosp.	18	487.5	450	18	487.5						
2	Surgical Hosp.	17	562.5	560	17	562.5						
3	Labor & Delivery	9	364	300	8	316						
4	Pediatrics Hosp.	14	288	105	6	113						
5	Radiology	23	17,547	20,000	26	21,119						
6	Pathology	25	312,850	330,000	27	346,396						
•	•											
•	•											
•	•											
•	•											
•	•											
40	•											

4.3 DETERMINE TOTAL FACILITY OUTPUT

This step requires the determination of some facility output which will be compared to the baseline output defined in section 4.1 to determine the incremental number of patients served and the incremental costs of serving those patients. This level, like the baseline level, is strictly a function of the decision model. It may be defined at any level desired, to include:

- Present Output
- Maximum Output
- Any Incremental Output

The incremental output (Total Facility Output minus Baseline Facility Output) is recorded in column (E) of Exhibit IV-2.

4.4 DETERMINE DEPARTMENTAL PRODUCT OUTPUT ASSOCIATED WITH TOTAL FACILITY OUTPUT

This step is concerned with determining the departmental product outputs demanded by the baseline plus incremental patients. This is accomplished as follows:

- Step 1. Knowing the total facility output, baseline plus incremental, by patient type, multiply the number of patients utilizing the department of Medical Hospitalization by their corresponding coefficients. That is, if there are 100 active duty, medical patient stay patients, each of whom would be expected to use 5.7 (the coefficient) bed days of Medical Hospitalization, multiply 100 by 5.7. Repeat this procedure for the other patient types utilizing this department.

- Step 2. Sum the products obtained in Step 1. The result is the total departmental products of Medical Hospitalization required for the total facility output.

- Step 3. Repeat Steps 1 and 2 for all other departments in the Table of Coefficients considering the following refinements:

  - Remember that for clinics departments composed of multiple clinics, the summed column will be that corresponding to each individual component clinic. There may be ten coefficients associated with Surgical Clinics, for example, to account for ten component clinics. Each component clinic column, then, must be summed.

  - The demands for the department of Medical Physicians will be the sum of the products of the demands for:

    .. Medical Hospitalization bed days times .25
    .. Internal Medicine Clinic visits times 1.0
    .. Allergy Clinic visits times 1.333

  - These factors (.25, 1.0 and 1.33) equate the workload measures of these departments to the product output measure of the department of Medical Physicians.

- The demands for the department of Surgical Physicians equals the sum of the products of the demands for:

  .. Surgical Clinic visits times 1.0

  .. Surgical Hospitalization I bed days (exclusive of demands for this department's products placed by gynecology patient types) times .5

  .. Podiatry Clinic visits times 1.125

  .. Urology Clinic visits times 1.5

  .. Ophthalmology Clinic visits times .75

  .. Orthopedic Clinic visits times 1.261.

- The demands for the department of OB/GYN physicians will equal the sum of the products of the demands for:

  .. OB/GYN Clinic visits associated with gynecology patient types times 1.0

  .. OB/GYN Clinic visits associated with obstetrics patient types times .762

  .. OB/GYN Hospitalization bed days associated with obstetrics patient types times .444

  .. Surgical Hospitalization I bed days associated with gynecology patient types times .444

- The demands for the department of Food Service consist of the sum of:

  .. The demands placed by patients by following Steps 1 and 2

  .. The demands placed by non-patients which is the number of personnel assigned times the average number of meals per person. The former is calculated by summing column (B) of Exhibit IV-3 and the latter is calucated as in section 3.1.5

Record the results in column (G) of Exhibit IV-3.

4.5 DETERMINE RESOURCES REQUIRED TO PRODUCE DEPARTMENT PRODUCTS ASSOCIATED WITH FACILITY OUTPUT

In this section, the object is to take the total departmental products obtained in section 4.4 and determine the resources in each department required to meet those product demands. In effect, one moves from the Table of Coefficients into the Departmental Tables. This is accomplished in the following steps:

- Step 1. Take the total product output of the department of Medical Hospitalization obtained in Step 1 of section 4.4 and place it in numerical sequence in the Departmental Table for this department

- Step 2. Determine the resources required to meet this product demand. These are the sum of all the resources associated with product output levels below that determined in Step 1.

- Step 3. Adjust this staffing level for local appraisal. This is accomplished be dividing the number obtained in Step 2 by the local appraisal factor for the department of Medical Hospitalization and rounding to the nearest whole number. The result is the staff needed to produce the departmental products demanded by the sum of baseline plus incremental patients. Record this result in column (H) of Exhibit IV-3.

- Step 4. Repeat Steps 1 through 3 for all other departments and record the results in column (H) of Exhibit IV-3.

4.6 COMPARE THE FACILITY OUTPUT PRODUCT LEVEL RESOURCE REQUIREMENTS WITH BASELINE LEVEL RESOURCES

This step is the comparison of the resource requirements determined in section 4.5 with the baseline resource levels defined in section 4.1. This can be accomplished by placing both levels on the same departmental table. Two resource levels must be compared. The first is a comparison of resources required to serve all patients (defined as required from column (H) of Exhibit IV-3) and the actual resources extant in each department (column (B) of Exhibit IV-3). The second is a comparison of required resources and those resources needed to produce actual products (defined as standard in column (E) of Exhibit IV-3). These two sets of differences are defined as the marginal staff and recorded in columns (I) and (J) respectively of Exhibit IV-3. Exhibit IV-9 presents examples of the results of sections 4.4 through 4.6. As may be seen, one of six different cases may arise from the above calculations. These are (corresponding to lines in Exhibit IV-9):

- Case 1 - Medical Hospitalization. The staff extant in this department is sufficient to serve the baseline facility output plus all incremental output.
  Result: 0 Marginal Staff

- Case 2 - Surgical Hospitalization. The staff extant in this department is sufficient to serve the baseline output but not the incremental output.

  Results: 1 Marginal Staff between Actual and Required
  1 Marginal Staff between Standard and Required.

- Case 3 - Labor and Delivery. The staff extant in this department is more than sufficient to serve the baseline facility output though insufficient to serve the total facility output.

  Result: 1 Marginal Staff between Actual and Required
  2 Marginal Staff between Standard and Required

- Case 4 - Pediatrics Hospitalization. The staff in this department is much more sufficient to serve both baseline and incremental patients. Like Labor and

Exhibit IV-9

Departmental Consolidation Table

LINE	Department	ACTUAL			STANDARD		Output Req'd to Serve Basic Plus Additional Patients	Staff Required to Serve Total Demand (G)	MARGINAL STAFF		MARGINAL STAFF COSTS	
		Staff	Constraint (Based on Actual Staff-B)	Output (Products Actually Produced)	Staff (Needed to Produce Actual Products-D)	Constraint (Based on Standard Staff-E)			Between Actual & Required (H - B)	Between Standard & Required (H -E)	Between Actual & Required (Costs of I)	Between Standard & Required (Costs of J)
	A	B	C	D	E	F	G	H	I	J	K	L
1	Medical Hosp.	18	487.5	450	18	487.5	479	18	0	0		
2	Surgical Hosp.	17	562.5	560	17	562.5	625	18	1	1		
3	Labor & Delivery	9	364	300	8	316	370	10	1	2		
4	Pediatrics Hosp.	14	288	105	6	113	159	9	(5)	3		
5	Radiology	23	17,547	20,000	26	21,119	22,000	27	4	1		
6	Pathology	25	312,850	330,000	27	346,396	340,000	27	2	0		
•	•											
•	•											
•	•											
•	•											
•	•											
40	•											

Delivery, however, the staff required to serve total output is greater than that necessary just to serve baseline patients.

Result: Minus 5 Marginal Staff between Actual and Required
3 Marginal Staff between Standard and Required

- Case 5 - Radiology. The staff in this department are insufficient to serve the baseline patients. And even if sufficient staff existed to serve baseline patients, they would be insufficient to serve baseline plus incremental patients.

  Result: 4 Marginal Staff between Actual and Required
  1 Marginal Staff between Standard and Required

- Case 6 - Pathology. The staff in this department is insufficient to serve the baseline patients. But those resources which are sufficient to serve the baseline patients are also sufficient to serve the incremental patients as well.

  Result: 2 Marginal Staff between Actual and Required
  0 Marginal Staff between Standard and Required

4.7 IDENTIFY RESOURCES WHICH MUST BE PURCHASED TO MEET THE TOTAL FACILITY OUTPUT

If the resources extant in a department are insufficient to meet the demands for that department's products, resources must be acquired. Referring to Exhibit IV-9, if the resources identified in column (H) are less than or equal to the resources identified in column (B), no resources need to be acquired. In the examples in Exhibit IV-9, these departments include:

- Medical Hospitalization
- Pediatrics Hospitalization.

Whenever the resources in column (H) are greater than those in column (B) (i.e., whenever a postive integer is found in column (H)), resources have to be acquired. In Exhibit IV-9 these include the departments of:

- Surgical Hospitalization
- Labor and Delivery
- Radiology
- Pathology

Two sets of resources may need to be acquired: those associated with the difference between actual and required; and those associated with the difference between standard and required. It must be pointed out that the difference between standard and required can never exceed the difference between actual and required for costing purposes. The marginal cost definition states that only resources required over and above those existing in the hospital are relevant. If the existing resources are greater than those required to serve the baseline patients, the excess provides capacity to serve some additional patients. If these baseline resources are sufficient to serve baseline plus incremental patients, no additional resources are required. If they are not sufficient (to serve baseline plus incremental patients), only the resources above the baseline are relevant. Therefore, the maximum number of resources that need to be acquired are those identified in column (H). The number of resources that need to be acquired in the example of Exhibit IV-9 are:

- Surgical Hospitalization:
  - 1 Between Actual and Required
  - 1 Between Standard and Required
- Labor and Delivery:
  - 1 Between Actual and Required
  - 1 Between Standard and Required
- Radiology:
  - 4 Between Actual and Required
  - 1 Between Standard and Required
- Pathology:
  - 2 Between Actual and Required
  - 0 Between Standard and Required

Futhermore, there are two types of resources that may need to be acquired. The marginal staff calculation was based on the difference between two staff requirements, each adjusted for local appraisal. Of the marginal staff so determined, a portion was necessary to accomplish the increase in workload. But this incremental staff was limited or aided by the particular characteristics of the departments. If sufficient additional staff are needed to serve the incremental patient load, these limitations or economies lead to incremental or decremental staff to account for the limitations or economies. For example, suppose the workload increase demanded by incremental patients yielded a marginal staff of 5 in a department (calculated as in this methodology). This depatment is further characterized by a local appraisal factor of .80. Of those 5, 4 were required strictly on the basis of workload (5 x .80) while the additional staff was required to account for the characteristics of the department limiting each resource.

To complete this step in the marginal cost calculation, it is necessary to identify the specific resources which must be acquired to serve incremental patients. This requires the determination of the marginal staff which are necessary based strictly on workload, and which are necessary to account for the limitations or economies. This process proceeds as follows:

- Step 1. Starting with column (I) of Exhibit IV-3, identify the first department which requires additional staff.

- Step 2. Multiply the number of staff identified in Step 1 by the local appraisal factor for that department and round to the nearest integer. The result is the number of staff required strictly on the basis of workload.

- Step 3. Go to the departmental table for that department and identify the resource associated with the constraint point (i.e., on the same line) identified in column (C). This is the first additional resource which must be acquired. Count this resource as one.

- Step 4. Continue counting until a number of resources equal to the number identified in Step 2 have been counted. These resources, identified by type and grade, are those that must be acquired.

- Step 5. Subtract the number identified in Step 2 from that in Step 1. This is the number of personnel that must be acquired or subtracted to account for the limitations or economies. If this number is negative, then the department has characteristics which yield economies (i.e., more staff is required based on workload than is required considering the characteristics of the department). If it is positive, then additional resources are necessary to account for limiting factors. These resources shall all be typed and graded as composite resources. Each departmental table contains a composite resource of that department.

- Step 6. Repeat Steps 1 through 5 for all departments with positive numbers in column (I).

- Step 7. Repeat Steps 1 through 5 for all departments with positive numbers in column (J) if column (J) is less than or equal to column (I).

If equipment resources are required in any department, identify that equipment.

4.8 DETERMINE COSTS OF PURCHASED RESOURCES

In this section, it is necessary to relate the resources identified in section 4.7 to the Personnel Resource Cost Tables. Since two sets of marginal staff were determined, two sets of costs are calculated. In Exhibit IV-3, column (K) presents the costs of the marginal staff in column (I) and column (L) presents the costs of the marginal staff in column (J). This process is as follows:

- Step 1. Take the resources, by type and grade, identified in Steps 4 and 6 of Section 4.7 and reference each to the Military Personnel Resource Cost Table.

- Step 2. Sum the costs of each resource. The result is the monthly military personnel cost of acquiring the resources in column (I).

- Step 3. Repeat Steps 1 and 2 for all resources identified in Steps 6 and 7 of Section 4.7.

If civilian costs are desired, the resource type need only be referenced to the Civilian Personnel Resource Cost Table instead of the Military Personnel Resource Cost Table. Exhibit IV-10 illustrates the completed departmental consolidation table for the six examples.

Exhibit IV-10

Departmental Consolidation Table

LINE	Department	ACTUAL			STANDARD		Output Req'd to Serve Basic Plus Additional Patients	Staff Required to Serve Total Demand (G)	MARGINAL STAFF		MARGINAL STAFF COSTS	
		Staff	Constraint (Based on Actual Staff-B)	Output (Products Actually Produced)	Staff (Needed to Produce Actual Products-D)	Constraint (Based on Standard Staff-E)			Between Actual & Required (H - B)	Between Standard & Required (H -E)	Between Actual & Required (Costs of I)	Between Standard & Required (Costs of J)
	A	B	C	D	E	F	G	H	I	J	K	L
1	Medical Hosp.	18	487.5	450	18	487.5	479	18	0	0	0	0
2	Surgical Hosp.	17	562.5	560	17	562.5	625	18	1	1	$ 675	$ 675
3	Labor & Delivery	9	364	300	8	316	370	10	1	2	$1,223	$1,223
4	Pediatrics Hosp.	14	288	105	6	113	159	9	(5)	3	0	0
5	Radiology	23	17,547	20,000	26	21,119	22,000	27	4	1	$3,104	$ 675
6	Pathology	25	312,850	330,000	27	346,396	340,000	27	2	0	$1,464	0
•	•											
•	•											
•	•											
•	•											
•	•											
40	•											

4.9 RELATE RESOURCE COSTS TO INCREMENTAL FACILITY OUTPUT

This section is necessary to determine which costs calculated in Section 4.8 are associated with which patients. It is the two sets of costs determined in section 4.8 which form the basis of the three marginal cost estimates. Essentially these three estimates can be described as follows:

- Case I (Column (F) of Exhibit IV-2). These are the marginal costs of serving each patient by type which costs include the costs of staff rectification. That is, this case includes the costs of purchasing resources which are needed to serve baseline patients regardless of incremental patients.

- Case II (Column (G) of Exhibit IV-2). This case includes only the costs of staff resources required to serve the incremental patients. It includes no costs of staff rectification.

- Case III (Column (H) of Exhibit IV-2). This case includes some but not all of the costs of rectification plus all the costs in Case II.

The costs attributable to rectification are determined by subtracting the costs in column (L) of Exhibit IV-2 from the costs in column (K). Therefore, the personnel costs included in Case I are all the costs in column (K) of Exhibit IV-3. The personnel costs in Case II are the costs in column (L) of Exhibit IV-3. The personnel costs in Case II are the costs in column (L) of Exhibit IV-3. The personnel costs in Case III are all of the costs in column (L) plus a portion of the difference in costs between columns (L) and (K).

To calculate the marginal costs per patient in a military hospital from the costs already determined, proceed as follows:

- Step 1. Starting with column (K), take the first department which contains a cost in column (K). These costs are then considered to be related to the incremental patients which used that department. (Example: Surgical Hospitalization, $675).

- Step 2. Take the incremental products demanded by incremental patients. This is the difference between

columns (G) and (D) of Exhibit IV-3. (Example: Surgical Hospitalization, 65).

- Step 3. Divide the number obtained in Step 1 by the number in Step 2. The result is the total additional cost of each additional product output of that department. (Example: $675/65 = $10.385).

- Step 4. Determine the incremental patients which required the incremental products (Example: assume 10 dependents of active duty and 10 retired surgical patient stay patient types only).

- Step 5. Multiply the number of incremental patients by type which required the products of this department by their appropriate coefficients to obtain the total products of this department required by each patient type (Example: 10 dependents of active duty patients x 2.6 bed days per patient = 26 bed days required by dependents of active duty patients; also 10 retired patients x 3.9 bed days = 39 bed days). The sum of all these numbers should equal the number obtained in Step 2 (e.g., 26 + 39 = 65).

- Step 6. Multiply the number obtained in Step 3 ($10.385) times each of the numbers obtained in Step 5 (e.g., 26 x $10.385 = $270; 39 x $10.385 = $405). The results are the incremental costs of this department associated to each patient type (e.g., $270 associated with the 10 dependents of active duty patients and $405 associated with the 10 retired patients). The sum of these numbers should equal the number obtained in Step 1 (e.g., $270 + $405 = $675). See Exhibit IV-11. This exhibit is an example of a worksheet that may be used to record the costs calculated in this step.

- Step 7. Repeat Steps 1 through 6 for all departments.

- Step 8. Sum the costs obtained in Step 1 through 7 across each patient type.

- Step 9. Divide the summed costs per patient type by the number of incremental patients of each type. The results are the personnel costs of Case I allocated to each patient type.

Exhibit IV-11

Sample Worksheet for the Allocation of Personnel Costs to Specific Patient Types

Patient Type			Departments								
Beneficiary	Service	Service Measure	Medical Hospital	Surgical Hospital	• • •	Radiology	• • •	Total	Patients	Marginal Staffing Cost Per Patient
Active Duty	Medical	Patient Stay								
		Ambulatory Clinic Visit								
	Surgical	Patient Stay								
		Ambulatory Clinic Visit								
	Obstetrics	Delivery								
	Gynecology	Patient Stay								
		Ambulatory Clinic Visit								
	Other	Patient Stay								
		Ambulatory Clinic Visit								
Dependents of Active Duty	Medical	Patient Stay								
		Ambulatory Clinic Visit								
	Surgical	Patient Stay								
		Ambulatory Clinic Visit								
	Obstetrics	Delivery								
	Gynecology	Patient Stay								
		Ambulatory Clinic Visit								
	Pediatrics	Patient Stay								
		Ambulatory Clinic Visit								
	Other	Patient Stay								
		Ambulatory Clinic Visit								
Retired	Medical	Patient Stay								
		Ambulatory Clinic Visit								
	Surgical	Patient Stay								
		Ambulatory Clinic Visit								
	Gynecology	Patient Stay								
		Ambulatory Clinic Visit								
	Other	Patient Stay								
		Ambulatory Clinic Visit								
Dependents of Retired & Survivors	Medical	Patient Stay								
		Ambulatory Clinic Visit								
	Surgical	Patient Stay								
		Ambulatory Clinic Visit								
	Obstetrics	Delivery								
	Gynecology	Patient Stay								
		Ambulatory Clinic Visit								
	Pediatrics	Patient Stay								
		Ambulatory Clinic Visit								
	Other	Patient Stay								
		Ambulatory Clinic Visit								

- Step 10. If equipment resources are required, reference the Equipment Resource Cost Table and repeat Steps 1 through 7 for each department.

- Step 11. Add to the costs obtained in Step 9 the materiel resource costs per patient type obtained from the Materiel Resource Cost Table and the equipment resource costs obtained in step 10. The results are the marginal costs per patient of health care delivered in this hospital assuming Case I. These costs so derived should be recorded in column (F) of Exhibit IV-2.

- Step 12. Repeat Steps 1 through 11 for the personnel costs in column (L) of Exhibit IV-3. The results should be recorded in column (G) of Exhibit IV-2 corresponding to Case II.

- Step 13. The completion of columns (H) of Exhibit IV-2 requires that the differences in costs between columns (L) and (K) of Exhibit IV-3 be divided such that only a part of these costs are allocated to the incremental patients. In this step then determine the departments for which there are different costs in columns (L) and (K).

- Step 14. For all departments not included in Step 13 (i.e., for all departments where the costs in column (L) are identical to those in column (K)), repeat steps 1 through 6 using the costs in column (L).

- Step 15. In the first department in Step 13 (assume Radiology), subtract the costs in column (L) from the costs in column (K) ($2,104 - 675 = $2,429). The result is the cost of rectification which must be allocated between incremental and baseline patients.

- Step 16. For this first department, subtract column (B) from column (F) (21,119 - 17,547 = 3,572). The result is the total capacity of the resources between baseline and standard.

- Step 17. Subtract column (D) from column (F) (Example: 21,119 - 20,000 = 1,119). The result is the additional capacity which needs to be acquired to serve incremental patients.

- Step 18. Divide the number obtained in Step 17 by the number obtained in Step 16 (1,119/3,572 = .3133). The result equals that portion of the resources required for rectification attributable to incremental patients.

- Step 19. Multiply the number obtained in Step 18 by the number obtained in Step 13 (Example: .3133 x $2,429 = $761).

- Step 20. Add the number in Step 19 to the cost in column (L).

- Step 21. Repeat Steps 1 through 6 for the costs obtained in Step 20.

- Step 22. Repeat Steps 16 through 21 for all other departments identified in Step 12.

- Step 23. Repeat Steps 8 through 11 for all departments whose costs were allocated in Steps 14, 21 and 22.

4.10 COMPARISONS WITH CHAMPUS

Given the decision framework discussed in Chapter I of this methodology, the process is not complete until the marginal costs obtained in section 4.9 are compared with the government costs of providing care to Military Health Services System eligible beneficiaries through CHAMPUS. This section details how to construct the CHAMPUS cost data into the patient types, and the comparisons with the marginal costs of heatlh care in the military facilities.

4.10.1 Constructing the CHAMPUS Cost Tables

CHAMPUS data are not available in the exact patient categories as the analysis framework for marginal costing. However, enough information is available to allow one to approximate the average cost of treating patients in each category (beneficiary x service x service measure) through CHAMPUS. Exhibits IV-12 and IV-13 illustrate the data formats available from OCHAMPUS. As may be seen, the following data are available concerning CHAMPUS users within a 40-mile radius of each military hospital:

- Hospital costs by age group for the following beneficiary types:
  - Dependents of Active Duty
  - Retired
  - Dependents of Retired and Survivors.
- Hospital costs by age group and beneficiary category for the following services:
  - Medical
  - Surgical
  - Obstetrics
  - Psychiatry.
- Physician costs for inpatient care by beneficiary and by service
- Outpatient costs by beneficiary, by service.

Two sets of CHAMPUS costs are relevant: the costs expended by the government and the costs expended by the patients themselves. The calculation of the government costs is as follows:

- Step 1. Determine pediatrics inpatient costs by first determining the average government cost for hospital care for dependents of active duty in the medical service for each age group up to age 14 (i.e., for the age groups less than 1, 1 through 4, 5 through 9, and 10 through 14). Do this again for surgical service.

Exhibit IV-12

Example of Inpatient Cost Data Available From OCHAMPUS

HOSPITAL SERVICES — PAGE 1 OF 2

FT. EUSTIS, MCDONALD, VA
ALL BRANCHES
DEPENDENTS OF ACTIVE DUTY PERSONNEL USER BENEFICIARIES
FOR PERIOD 01/01/75 THRU 12/31/75

	DELIVERY			PSYCHOTHERAPEUTIC /PSYCHIATRIC			MEDICAL		
	NUMBER OF ADMISSIONS	TOTAL HOSP. DAYS	TOTAL GOVT COST	NUMBER OF ADMISSIONS	TOTAL HOSP. DAYS	TOTAL GOVT COST	NUMBER OF ADMISSIONS	TOTAL HOSP. DAYS	TOTAL GOVT COST
MALES (TOTAL)	0	0	0	437	10,486	1,470,177	237	1,342	286,284
AGE LESS THAN 1	0	0	0	0	0	0	101	786	136,455
1 THRU 4	0	0	0	5	41	9,580	69	277	33,178
5 THRU 9	0	0	0	46	1,327	180,041	26	77	9,121
10 THRU 14	0	0	0	146	4,862	715,435	12	73	7,222
15 THRU 19	0	0	0	146	3,884	516,065	11	121	17,257
20 THRU 24	0	0	0	14	352	47,055	10	256	13,048
25 THRU 34	0	0	0	0	0	0	0	0	0
35 THRU 44	0	0	0	0	0	0	0	0	0
45 THRU 54	0	0	0	0	0	0	0	0	0
55 THRU 64	0	0	0	0	0	0	0	0	0
65 & OVER	0	0	0	0	0	0	0	0	0
FEMALES (TOTALS)	865	3,377	615,103	1,240	23,239	3,017,677	562	3,050	402,659
AGE LESS THAN 1	0	0	0	0	0	0	72	414	125,065
1 THRU 4	0	0	0	0	0	0	56	232	28,517
5 THRU 9	0	0	0	23	704	106,382	28	130	15,238
10 THRU 14	0	0	0	116	2,841	405,819	10	58	7,126
15 THRU 19	163	601	111,366	185	4,067	554,644	46	172	18,941
20 THRU 24	366	1,414	255,570	196	3,473	426,781	111	386	39,593
25 THRU 34	304	1,223	222,061	464	7,646	978,805	139	904	93,587
35 THRU 44	32	139	26,105	211	1,692	447,905	75	490	57,332
45 THRU 54	0	0	0	41	768	85,783	19	261	21,240
55 THRU 64	0	0	0	4	48	6,549	0	0	0
65 & OVER	0	0	0	0	0	0	0	0	0
ALL PATIENTS									
AGE LESS THAN 1	0	0	0	0	0	0	173	1,205	329,540
1 THRU 4	0	0	0	5	41	9,580	125	509	61,696
5 THRU 9	0	0	0	71	2,033	286,423	55	207	24,359
10 THRU 14	0	0	0	262	7,703	1,121,254	22	131	14,348
15 THRU 19	163	601	111,366	331	7,951	1,070,709	57	293	36,198
20 THRU 24	366	1,414	255,570	210	3,825	473,836	121	642	52,692
25 THRU 34	304	1,223	222,061	464	7,646	978,805	139	904	93,587
35 THRU 44	32	139	26,105	211	1,692	447,905	75	490	57,332
45 THRU 54	0	0	0	41	768	85,783	19	261	21,240
55 THRU 64	0	0	0	4	48	6,549	0	0	0
65 & OVER	0	0	0	0	0	0	0	0	0
TOTAL ALL PATIENTS	865	3,377	615,103	1,677	33,725	4,487,854	799	4,642	688,943
USER BENEFICIARIES	861			709			751		
AVERAGE LENGTH OF STAY (DAYS)	3.9			29.1			5.8		
AVERAGE DAILY PATIENT LOAD	9.2			92.1			12.7		
PERCENT RESIGNING APART FROM SPONSOR	15.4			5.4			13.8		
TOTAL GOVERNMENT COSTS	615,103			4,487,854			688,943		
TOTAL PATIENT COSTS	22,792			138,241			25,243		
TOTAL GOVT & PATIENT COSTS	637,295			4,626,146			714,187		
AVG GOVT COST PER PATIENT DAY	182.15			133.01			148.42		
AVG PATIENT COST PER PATIENT DAY	6.51			4.10			5.44		
AVG TOTAL COST PER PATIENT DAY	188.72			137.11			153.85		
AVG GOVT COST PER ADMISSION	711.10			2,676.12			862.26		
AVG PATIENT COST PER ADMISSION	26.66			82.46			31.59		
AVG TOTAL COST PER ADMISSION	736.76			2,758.58			893.85		

PROFESSIONAL SERVICES (INPATIENT)

	DELIVERY	PSYCHOTHERAPEUTIC /PSYCHIATRIC	MEDICAL
TOTAL GOVERNMENT COSTS	338,928	1,022,448	192,215
TOTAL PATIENT COSTS	0	0	165
TOTAL GOVT & PATIENT COSTS	338,928	1,022,448	192,380

Exhibit IV-12 — Cont.

HOSPITAL SERVICES

FT. EUSTIS, MCDONALD, VA
ALL BRANCHES
DEPENDENTS OF ACTIVE DUTY PERSONNEL USER BENEFICIARIES
FOR PERIOD 01/01/75 THRU 30/06/76

	SURGICAL			TOTAL-ALL CARE		
	NUMBER OF ADMISSIONS	TOTAL HOSP. DAYS	TOTAL GOVT COST	NUMBER OF ADMISSIONS	TOTAL HOSP. DAYS	TOTAL GOVT COST
MALES (TOTAL)	491	1,230	266,645	1,165	13,338	2,023,107
AGE LESS THAN 1	22	200	65,109	125	986	266,566
1 THRU 4	193	349	77,255	267	687	120,014
5 THRU 9	199	400	80,001	271	1,804	269,164
10 THRU 14	51	198	34,595	249	5,133	757,256
15 THRU 19	21	66	11,136	218	4,273	561,009
20 THRU 24	5	17	2,947	35	625	93,191
25 THRU 34	0	0	0	0	0	0
35 THRU 44	0	0	0	0	0	0
45 THRU 54	0	0	0	0	0	0
55 THRU 64	0	0	0	0	0	0
65 & OVER	0	0	0	0	0	0
FEMALES (TOTALS)	1,601	6,607	1,194,169	4,268	36,213	5,234,589
AGE LESS THAN 1	17	97	25,463	89	508	148,549
1 THRU 4	159	386	93,361	215	618	121,879
5 THRU 9	169	348	68,370	222	1,184	193,161
10 THRU 14	55	152	31,311	107	3,051	464,253
15 THRU 19	82	243	61,500	476	5,083	724,459
20 THRU 24	178	690	117,451	891	5,963	841,256
25 THRU 34	593	2,608	445,876	1,500	12,381	1,744,331
35 THRU 44	302	1,738	314,565	620	6,059	845,912
45 THRU 54	39	253	39,385	99	1,280	146,409
55 THRU 64	7	100	21,703	9	148	28,332
65 & OVER	0	0	0	0	0	0
ALL PATIENTS						
AGE LESS THAN 1	39	297	85,573	214	1,492	415,113
1 THRU 4	352	737	170,616	482	1,305	241,893
5 THRU 9	368	748	148,371	493	2,988	462,325
10 THRU 14	106	350	65,907	356	8,183	1,221,510
15 THRU 19	103	309	73,237	694	9,356	1,285,468
20 THRU 24	183	707	120,398	886	6,588	934,398
25 THRU 34	593	2,608	445,876	1,500	12,381	1,744,331
35 THRU 44	302	1,738	314,565	620	6,059	845,912
45 THRU 54	39	253	39,385	99	1,280	146,409
55 THRU 64	7	100	21,703	9	148	28,332
65 & OVER	0	0	0	0	0	0
TOTAL ALL PATIENTS	2,092	7,837	1,465,795	5,433	49,581	7,257,697
USER BENEFICIARIES		1,980			4,091	
AVERAGE LENGTH OF STAY (DAYS)		3.7			9.1	
AVERAGE DAILY PATIENT LOAD		21.4			135.5	
PERCENT RESIDING APART FROM SPONSOR		8.1			15.4	
TOTAL GOVERNMENT COSTS		1,465,795			7,257,697	
TOTAL PATIENT COSTS		61,124			246,852	
TOTAL GOVT & PATIENT COSTS		1,526,919			7,504,549	
AVG GOVT COST PER PATIENT DAY		181.04			140.38	
AVG PATIENT COST PER PATIENT DAY		7.60			4.78	
AVG TOTAL COST PER PATIENT DAY		194.03			151.36	
AVG GOVT COST PER ADMISSION		700.67			1,335.85	
AVG PATIENT COST PER ADMISSION		29.22			45.44	
AVG TOTAL COST PER ADMISSION		729.89			1,381.29	

PROFESSIONAL SERVICES (INPATIENT)

	SURGICAL	TOTAL-ALL CARE
TOTAL GOVERNMENT COSTS	576,698	2,130,312
TOTAL PATIENT COSTS	831	1,096
TOTAL GOVT & PATIENT COSTS	577,630	2,131,408

Exhibit IV-13

Example of Outpatient Cost Data Available from OCHAMPUS

PROFESSIONAL SERVICES (OUTPATIENT)

FT. EUSTIS, MCDONALD, VA
ALL BRANCHES
DEPENDENTS OF ACTIVE DUTY PERSONNEL USER BENEFICIARIES
FOR PERIOD 01/07/75 THRU 30/06/76

	DELIVERY	PSYCHOTHERAPEUTIC /PSYCHIATRIC	MEDICAL	SURGICAL	TOTAL ALL CARE
SER BENEFICIARIES	23	1,719	2,675	1,158	5,009
UMBER OF OUTPATIENT VISITS BY AGE					
TOTAL VISITS BY MALES	0	3,302	2,733	108	6,143
AGE LESS THAN 1	0	4	228	13	245
1 THRU 4	0	102	911	16	1,029
5 THRU 9	0	869	886	17	1,772
10 THRU 14	0	1,331	434	32	1,795
15 THRU 19	0	818	247	32	1,117
20 THRU 24	0	144	27	0	171
25 THRU 34	0	6	0	0	6
35 THRU 44	0	8	0	0	8
45 THRU 54	0	0	0	0	0
55 THRU 64	0	0	0	0	0
65 & OVER	0	0	0	0	0
TOTAL VISITS BY FEMALES	25	13,091	5,125	886	19,127
AGE LESS THAN 1	0	19	209	1	229
1 THRU 4	0	44	562	25	631
5 THRU 9	0	259	456	28	743
10 THRU 14	0	631	337	15	983
15 THRU 19	0	1,114	145	113	1,422
20 THRU 24	1	1,555	339	184	2,079
25 THRU 34	17	5,485	1,533	345	7,880
35 THRU 44	7	3,101	1,148	147	4,403
45 THRU 54	0	365	343	24	732
55 THRU 64	0	18	3	4	25
65 & OVER	0	0	0	0	0
ALL PATIENTS-AGE UNDER 1	0	23	437	14	474
1 THRU 4	0	146	1,473	41	1,660
5 THRU 9	0	1,128	1,342	45	2,515
10 THRU 14	0	1,962	771	45	2,778
15 THRU 19	0	1,952	442	145	2,539
20 THRU 24	1	1,699	366	184	2,250
25 THRU 34	17	5,991	1,533	345	7,886
35 THRU 44	7	3,109	1,148	147	4,411
45 THRU 54	0	365	343	24	732
55 THRU 64	0	18	3	4	25
65 & OVER	0	0	0	0	0
TAL NUMBER OF OUTPATIENT VISITS	25	16,393	7,858	994	25,270
VERNMENT COSTS	2,518	447,674	224,831	174,033	849,057
TIENT COSTS	741	174,713	134,614	57,359	367,329
TAL COSTS	3,260	622,388	359,445	231,293	1,216,387
G GOVT COST PER VISIT	104.75	27.31	28.61	175.08	33.60
G PATIENT COST PER VISIT	29.66	10.66	17.13	57.61	14.54
G TOTAL COST PER VISIT	130.41	37.97	45.74	232.69	48.14

- Step 2. Add all patients 14 and under in the medical service to those in the surgical service. This is the total pediatrics patients served.

- Step 3. Multiply the average cost per patient in the first age group of medical service (i.e., less than 1) by the ratio of patients in that group to total pediatrics patients (obtained in Step 2). Repeat for all age groups for medical and surgical service.

- Step 4. Sum all the numbers obtained in Step 3. This figure is the weighted average hospital costs per pediatric, dependent of active duty patient.

- Step 5. To the above must be added the physician costs. This is accomplished by:

  - Multiplying the ratio of medical care patients 14 and under to total pediatrics patients (obtained in Step 2) times the average physician costs for medical care patients (total costs divided by total patients). Repeat for surgical patients 14 and under and sum the numbers.

  - Adding the dollars above to the dollars obtained in Step 4 to arrive at the total weighted average cost for a dependent of active duty, pediatrics, patient stay patient type.

- Step 6. Repeat Steps 1 through 5 for dependents of retired to determine the weighted average cost for a dependent of retired, pediatrics, patient stay patient type.

- Step 7. Determine the costs for dependents of active duty, medical patient stay, patient type. This is accomplished by:

  - Determining the average cost per patient in each age group over 14

  - Multiplying the average cost obtained above by the ratio of patients in each age group over 14 to the total of all patients in age groups over 14 and summing the results.

  - Adding the average government cost of physicians in the medical service to arrive at the total average cost of a dependent of active duty, medical patient stay patient type.

- Step 8. Repeat Step 7 for dependents of active duty, surgical patient stay patient types.

- Step 9. Repeat Steps 7 and 8 for dependents of retired, medical and surgical, patient stay patient types.

- Step 10. Determine the costs for dependents of active duty, obstetrics, delivery patient types by adding together the average hospital costs per patient and the average physician cost per patient.

- Step 11. Repeat Step 10 for dependents of retired, obstetrics, delivery patient types.

- Step 12. Determine the average costs for retired, medical patient stay patient types by adding together the average hospital costs per retired medical patient and the average physician costs for the same patient.

- Step 13. Repeat Step 12 for the following patient stay patient types:

  - Retired surgical
  - Dependents of retired other
  - Dependents of active duty other
  - Retired other

- Step 14. Determine the costs of all gynecology patient stay patient types by assuming these costs are identical to the costs for surgical, patient stay patient types.

- Step 15. The average costs for all ambulatory clinic visit patient types, except pediatrics, are the average outpatient visit costs per beneficiary category and service (again assume gynecology is equivalent to surgery).

- Step 16. The pediatrics ambulatory clinic visit costs are the average medical service outpatient costs plus

the average surgical service outpatient costs each weighted by the number of patients in each service relative to the total patients in both services.

- Step 17. The results of Steps 1 through 16 are the government CHAMPUS costs of serving each patient type less pharmaceutical and administrative costs. To determine the pharmaceutical costs applicable to each patient type, first obtain from OCHAMPUS the total dollar expenditure for pharmaceuticals in the base year and the total number of prescriptions filled which led to the pharmaceuticals costs. Then compute an average cost per prescription (currently approximately $4.41).

- Step 18. Since prescriptions, as determined in Step 17, apply only to ambulatory clinic visit patient types, multiply the average cost per prescription obtained in Step 17 by the coefficient of Pharmacy applicable to dependent of active duty medical ambulatory clinic visit patient types. The result is the expected government CHAMPUS costs of pharmaceuticals applicable to this patient type.

- Step 19. Add the cost determined in Step 18 to the other government CHAMPUS costs obtained previously for this patient type.

- Step 20. Repeat Steps 18 and 19 for all other ambulatory clinic visit patient types using the appropriate coefficient of the department of Pharmacy.

- Step 21. The administrative costs applicable to each patient type is first estimated by obtaining from OCHAMPUS the following information:

  - The processing cost per claim negotiated with the fiscal intermediary in the state in which the hospital is located.

  - The number of outpatient visits per claim by beneficiary category.

- Step 22. Assuming two claims per patient stay and delivery (one for the hospital and one for professional services), multiply the processing cost per claim times

two and add this cost to the government CHAMPUS cost for every patient stay and delivery patient type.

- Step 23. Divide the processing cost by the number of visits per claim for dependents of active duty. Add the result to the government CHAMPUS cost for every dependent of active duty ambulatory clinic visit patient type.

- Step 24. Repeat Step 23 for the other beneficiary categories. The results of these calculations are the government CHAMPUS costs per patient type including estimates of pharmaceutical and administrative processing costs and should be recorded in column (I) of Exhibit IV-2.

The calculation of CHAMPUS patient costs proceeds as follows:

- Step 25. All that is known about patient costs are the total by service (hospital plus professional). However, if it is assumed that patients incur costs in the same ratios that the government incurs costs, then the government costs can be used to estimate the patient costs by patient type. In this step then, for dependents of active duty, construct a worksheet as in Exhibit IV-14 (pediatrics patients are any patients under 14).

- Step 26. Divide line 3 by line 4 (result: .624).

- Step 27. Multiply the result of Step 26 times line 5 (result: 15,854).

- Step 28. Divide the result of Step 27 by line 1 (result: 41.94).

- Step 29. Multiply the result of Step 28 by the dividend of line 1 divided by the sum of lines 1 and 6 (result: 41.94 x (378/1,243) = (12.75).

- Step 30. Divide line 8 by line 9 (result: .3211).

- Step 31. Multiply the result of Step 30 times line 10 (result: $19,926).

Exhibit IV-14

Data Needed to Determine Patient CHAMPUS Costs

Line	Item Description	DATA	
		Dependents of Active Duty	Dependents of Retired
1	Medical Pediatrics Patients	378	
2	Total Medical Patients	799	
3	Medical Pediatrics Costs	$ 429,914	
4	Total Medical Costs	$ 688,943	
5	Total Medical Patient Costs	$ 25,407	
6	Surgical Pediatrics Patients	865	
7	Total Surgical Patients	2,092	
8	Surgical Pediatrics Costs	$ 470,667	
9	Total Surgical Costs	$1,465,795	
10	Total Surgical Patient Costs	$ 62,055	

- Step 32. Divide the results of Step 31 by line 6 (result: 23.04).

- Step 33. Multiply the result of Step 32 times the dividend of line 1 divided by the sum of lines 1 and 6 (result: 23.04 x (865/1,243) = 16.03).

- Step 34. Add the results of Steps 33 and 29 (result: $29). The result is the calculated average patient cost of a dependent of active duty patient stay patient type in CHAMPUS.

- Step 35. Repeat Steps 25 through 34 for dependent of retired pediatrics patient stay patient types.

- Step 36. Subtract line 3 from line 4 and divide the remainder by line 4 (result: .376).

- Step 37. Multiply the result of Step 36 by line 5 (result: 9,553).

- Step 38. Divide the result of Step 37 by the difference between lines 2 and 1 (result: $9,553 (799 - 378) = $23). The result is the average CHAMPUS patient cost for a dependent of active duty patient stay patient type.

- Step 39. To determine the average CHAMPUS patient cost for a dependent of active duty surgical patient stay patient type, repeat Steps 36 through 38 using lines 6 through 10 of Exhibit IV-14.

- Step 40. Repeat Steps 36 through 39 for dependent of retired patient types.

- Step 41. The CHAMPUS patient costs for obstetrics patients is the sum of the patient hospital costs (Example: 22,192) and professional costs (0) divided by the total CHAMPUS obstetrics patients (865). The result of this example is $26.

- Step 42. The CHAMPUS patient costs for retired beneficiaries is the sum of the patient hospital plus professional services costs by service category divided by the number of patients in each category.

- Step 43. The CHAMPUS patient costs for all ambulatory clinic visit patient types, except pediatrics, is the patient costs by beneficiary and service category divided by the number of patients in each category.

- Step 44. Divide the number of dependent of active duty medical ambulatory clinic visit patient types using CHAMPUS by the total of these plus the number of dependent of active duty surgical ambulatory clinic visit types.

- Step 45. Multiply the result of Step 44 by the average patient cost per dependent of active duty medical clinic visit.

- Step 46. Repeat Steps 44 and 45 for dependent of active duty surgical clinic visits in CHAMPUS.

- Step 47. Add the results of Steps 45 and 46. The result is the CHAMPUS patient cost of a dependent of active duty pediatrics ambulatory clinic visit patient type.

- Step 48. Repeat Steps 45 and 47 for dependent of retired patient types.

- Step 49. The CHAMPUS patient costs of gynecology patient stay and ambulatory clinic visit patient types are identical to the patient CHAMPUS costs of surgical patient stay and ambulatory clinic visit patient types respectively within each beneficiary category (e.g., the CHAMPUS patient cost of a dependent of active duty gynecology patient stay patient type is identical to the CHAMPUS patient cost of a dependent of active duty surgical patient stay patient type).

- Step 50. The results of Steps 25 through 49 should be recorded in column (J) of Exhibit IV-2.

- Step 51. Column (K) of Exhibit IV-2 is completed by merely summing columns (I) and (J) across each line.

4.10.2 Comparison of CHAMPUS to Facility Marginal Costs

In section 4.9, the marginal cost associated with each patient by type was determined. This can now be directly compared with the average CHAMPUS costs per patient by type developed in section 4.10.1. where CHAMPUS costs are higher, the patients may more cheaply be served in the military facility. Where the opposite is true, it may be more economical to provide heatlh care to those patients through CHAMPUS, all other circumstances considered.

V. METHODOLOGICAL ISSUES

In the development and use of the marginal cost model in military medical treatment facilities, many methodological issues were addressed. The marginal cost methodology is straightforward to utilize, but its development required a rigorous application of analytical skills to ensure that the resultant model met the objectives of the study. The purpose of this chapter is to discuss the basic assumptions of the methodology, the validity of the model, and the sensitivity of the model.

BASIC MODEL ASSUMPTIONS

This manual prescribes a methodology for building and using a cost model of a military medical treatment facility so as to predict, given certain assumptions, the marginal cost of health care provided in that facility. The methodology itself was developed on the basis of another set of assumptions, especially about the observed utilization of health resources. These assumptions are explicitly stated so that the reader understands the model's construction, its limitations, and its potential for enhancing the decision making process.

The first assumption is that the base year reflects the future. By necessity, this model must be built around historical data and thus base year data are used. It is understood that history is not a predictor, only a precursor. Thus, what happened in the base analysis year may not predict what will happen in future years.

The next assumption is that the hospital structure remains essentially the same from the base year into the future. However, it is common for hospital departments (especially clinics) to be restructured over one or more years. Furthermore, it is assumed that the structural form that the hospital uses, is

the optimally efficient one. It is also assumed that the model reflects a quality level consistent with the quality of care provided in the base year. If that level is unacceptable, the model would have to be completely reconstructed.

The model further assumes that the coefficients reflect the true utilization of departmental products by defined patient types. Three issues impact this assumption. The first is that it is impossible to predict with 100% accuracy the actual services that will be demanded by individual patients. Only an expected demand can be estimated based on historical data. The second issue involves error. Many of the coefficients are developed using standard statistical techniques with an assumed error rate . However, the variability around some means (notably the average outpatient utilization of Pathology) are as high as 300% to 400%.

The third issue concerns the methodology itself. Sometimes it was not possible to determine the specific users (by patient class) of departmental product outputs. In those cases, other techniques were used which may over or under allocate actual products to patients. Ratio analysis, for example, was used to allocate some of the products of the department of Pharmacy to specific beneficiary classes within service classes. And this technique assumes identical utilization of products by each beneficiary regardless of classification.

Several assumptions were necessary in developing the departmental tables. These are explicitly stated in section 3.2. But even more fundamental is the reasonableness of the staffing guide itself. Numerous criticisms of this guide have been made, but its reasonableness is enhanced by its consistent use in establishing manpower requirements at every Army hospital.

Another consideration is whether the constraint points in the departmental tables are really constraint points. Is it possible to sustain levels of product output above constraint points with fewer resources than would be indicated? This question is impossible to answer without detailed work measurement studies unique to each hospital. In their absence, however, it was assumed that these levels are reasonable and the resource associated with each level should be acquired to increase product output beyond those levels.

In using the methodology, a marginal cost for a defined increment of patients served may be calculated. This increment may breach constraints which may or may not result in marginal costs greater than CHAMPUS costs. It may be more advantageous to determine an optimum mix of patients that could be served breaching no constraints. The determination of an optimum mix of incremental patients served, however, requires a finite but a very large number of calculations which trade off different types of patients served with their associated demand for departmental products. To do this by hand is not feasible but it is expected that an automated system (aside from a linear programming model which goes beyond even this decision) to determine that optimum mix is feasible.

It is important to point out that it is not the objective of this methodology to determine which patient types should be served in the facility. This manual merely sets forth a methodology to determine the services of the hospital required by specific patient types and the costs associated with serving additional patients. It is to be understood, however, that the additional demand for hospital services above what is presently being demanded is constrained by the total number of patients served through CHAMPUS.

A final consideration is that costs change over time irrespective of marginality. Some causes of this cost behavior include:

- Annual cost of living increases in pay rates
- General rates of inflation affecting materiel costs
- The purchase of labor saving capital equipment
- Increased or decreased efficiencies in the delivery of health care
- Increases or decreases in the utilization of temporary borrowed labor (e.g., volunteers).

These issues ultimately affect the accuracy of predicted costs where the marginal costs are compared to those actually incurred. It is not possible to account for some of these issues

in the methodology. Inflation of personnel and materiel costs can be accounted for with revised resource cost tables but increases or decreases in relative efficiency cannot.

In order to ensure the validity and reliability of the Table of Coefficients, however, a test should be performed. This test is described in the following section.

VALIDITY

If the Table of Coefficients is reasonable and reliable, it will be possible to predict the departmental products that would be demanded by any mix of patients served. That is, if patient data from some time period before or after the base year is multiplied through the Table of Coefficients, the resulting departmental products should not differ from the actual products experienced during that same time period by a significant amount. A reasonable deviation is considered to be 10% above or below actual. The steps used to perform this validation analysis are as follows:

- Step 1. Choose at least three months of patient data from a time period other than the base analysis year which should include:
  - Patients served classified by beneficiary, service and service measure
  - The product outputs of each hospital department in the Table of Coefficients.
- Step 2. For the first month, multiply the patients served through the Table of Coefficients following the procedures detailed in Section 4.4.
- Step 3. Repeat Step 2 for each of the other two months.
- Step 4. Match the data calculated in Steps 2 and 3 with the actual departmental products produced during each of those three months and display this data as in Exhibit V-1.
- Step 5. In each department in each month, subtract the actual products from the predicted products. The results are the absolute differences.

Exhibit V-1

Worksheet to be Used to Test the Validity of the Table of Coefficients

Department	Month 1				Month 2				Month 3				Quarter			
	Actual	Predicted	Difference #	Difference %	Actual	Predicted	Difference #	Difference %	Actual	Predicted	Difference #	Difference %	Actual	Predicted	Difference %	Difference #

- Step 6. The percentage differences are calculated by dividing the absolute differences obtained in Step 5 by the actual products.

- Step 7. Sum the actual and predicted products in each department for the quarter and repeat steps 5 and 6 for the quarterly data.

The most important data is the quarterly data. If, in most departments (e.g., more than 80%) the predicted products differ from actual by less than 10% over the quarter, then the Table of Coefficients can be considered valid. However, for all departments in which predicted products differ from actual by more than 10%, the sources of this variation should be explored. Such sources might include, but are not limited to, those described in the following paragraphs.

Structual Changes

If the predicted products differ from actual by more than 10% consistently in the same direction in each of the three months (i.e., in each month the difference is consistently over or under the actual), then structural changes may have occurred. This is especially possible in the clinics departments. Structural changes include:

- Realignment of resources among departments so as to increase the productive capacity of some at the expense of others. Since the number of products that can be delivered in a department is constrained by the resources in that department, this realignment will alter the number of products actually produced

- Restructuring of departments. Departments may be closed, new ones opened or others combined.

- Loss of resources without replacement. The effects here are similar to the first one above. The loss of an internist, for example, may lead to a decrease in the services provided in the Internal Medicine Clinic relative to all other medical clinics and therefore the coefficient is no longer valid.

Workload Reporting Changes

The method of reporting departmental products may change between the base year and the months in the analysis year. This leads to inaccurate coefficients.

Inherent Variability

The coefficients, being mean values, assume a certain variability. If this variability is large (e.g., over 100% of the mean), it could affect the predictions. In the case of Pathology, for instance, the variability around the coefficients is as high as 400%. Therefore, if predicted outputs differ from actual by more than 10%, a difference as high as 50% would not be unusual.

To ensure the continued validity of the Table of Coefficients, it is recommended that some minimal maintenance be performed monthly and somewhat more extensive maintenance annually. On a monthly basis the coefficients for the Hospitalization and Clinics Departments should be reconstructed. The coefficients for the former are average length of stay. Since this statistic tends to fluctuate, two maintenance measures may be performed. The first is to maintain a 12 month moving average. This operates as follows:

- Start from the base 12 months data for CY 1976 which are the total patients and bed days organized by beneficiary and service type
- In February, 1977, add the total patients and bed days (organized by beneficiary and service category) experienced in January, 1977 to the base
- Drop the data for January, 1976 from the base
- Calculate the new average lengths of stay by beneficiary and service (for the period February, 1976 through January, 1977)
- In March, 1977 add the data for February, 1977 and drop the data for February, 1976 (thus this calculation results in average lengths of stay for the 12 month period, March, 1976 through February, 1977)

This moving average will tend to reflect the latest trend in utilization of the Hospitalization Departments by specific patient types. An alternative to the 12 month moving average is to merely add data for each new month to the base. In August, 1977, this would result in a 19 month base of data (January, 1976 through July, 1977). This technique merely tends to minimize the fluctuations in average length of stay.

The Clinics Departments are more often affected by organizational changes than any other hospital department. Therefore, it is recommended that the data leading to the coefficients for these departments be closely monitored monthly. This may be accomplshed by organizing monthly clinic visits into beneficiary and service categories then computing the coefficients per the methodology manual. If the recomputed coefficients differ significantly (i.e., more than 10%) from those found in the Table of Coefficients, than the latter will need to be changed.

SENSITIVITY

Related to the issue of validity is sensitivity. To what circumstances is the model sensitive such that calculated marginal costs are invalid or unreasonable. Ultimately this issue concerns the sensitivity of the Table of Coefficients and Departmental Tables as constructed for individual hospitals. In general these tables can be used as constructed in accordance with this methodology to predict valid and reasonable marginal costs as long as the following circumstances prevail:

- The organizational structure of the hospital remains essentially unchanged
- The mix of patient types served remains essentially unchanged
- The mission of the host installation remains essentially unchanged
- The technology of medicine remains essentially unchanged
- No massive workload increases are anticipated.

That is, the model, as a predictor of marginal costs, is quite sensitive to the above circumstances.

The coefficients for each hospital are developed from some base year data. As such, their future usefulness depends upon a requirement that the organizational structure of the hospital remains essentially unchanged from the base year. If the structure of the outpatient clinics is changed, for example, or resources in these clinics are reallocated, the coefficients relating the use of the departments of Medical, Surgical, OB/GYN, Pediatrics and Other Clinics would also have to be changed to reflect this new organization. Similarly, if inpatient wards are combined or separated for whatever reasons, this reorganization would affect the coefficients for the Departments of Medical, Surgical, OB/GYN, and Pediatrics Hospitalization, Medical Maintenance, Medical Materiel, Linen, and even Pharmacy.

The second factor to which the model is sensitive is the mix of patient types. In general, the development of the coefficients was not dependent upon the mix of patients. That is, if one patient type (e.g., dependent of retired, obstetrics, delivery patient type), were denied care in an MTF due to insufficient resources, this situation should generally not affect the coefficients pertaining to all other patient types. But in a situation where whole beneficiary categories are denied the services of a hospital, the care provided to remaining patient types may be so different as to require the redevelopment of the Table of Coefficients.

Related to the above is the requirement that the mission of the host installation remains unchanged. If a post becomes the home of a combat division, instead of a training and research installation, the type of demand for medical services by two of the four beneficiary categories will probably change. Therefore, if the mission of the host facility changes, the demand for departmental product outputs by specific patient types will change, necessitating a new Table of Coefficients.

A change in the technology of medicine may also drastically alter the Table of Coefficients. Changes in the technology of medicine means, among other things, changes in assumptions about length of stay requirements, necessary diagnostic tests, surgical procedures, chemotherapy, as well as technological improvements in non-human resources. A significant change in any of these

factors will probably alter the consumption rate (i.e., the coefficients) of departmental products by patients and necessitate changes in the Table of Coefficients.

As in all marginal cost analyses, the analysis of the marginal costs of health care at an Army hospital are only valid over some "relevant range of activity". That implies that an analysis of marginal costs which assumes an output level significantly larger or smaller than that experienced during the base period (1976) may not be valid. Although it is believed that this relevant range of activity is quite broad, the marginal costs in a facility become more tenuous when massive workload shifts are assumed.

Changes in the physical structure of an Army hospital may also affect the Table of Coefficients, insofar as these changes affect the other circumstances. Physical changes, in and of themselves, should not affect the consumption rate of departmental products by patients. However, construction, changes in clinic location, renovations and other physical changes may alter organizational structure or the patient types that may be served. This alteration may then affect the coefficients.

Used with caution, then, the methodology can be used to calculate valid and reasonable marginal costs of serving additional patients in an Army hospital.